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THE GROWTH

OF

INDUSTRIAL ART.

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HON. BENJ. BUTTERWORTH,

COMMISSIONER OF PATENTS AND REPRESENTATIVE OF THE DEPARTMENT OF THE INTERIOR ON UNITED STATES GOVERNMENT BOARD,

CINCINNATI INDUSTRIAL EXPOSITION, CINCINNATI, OHIO;

SOUTHERN EXPOSITION, LOUISVILLE, KENTUCKY;

THE WORLD'S INDUSTRIAL AND COTTON CENTENNIAL EXPOSITION,

NEW ORLEANS, LOUISIANA.

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WASHINGTON:
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ALPHABETICAL INDEX.

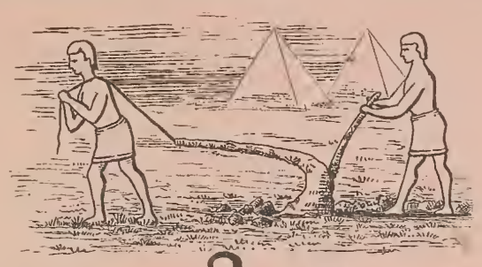
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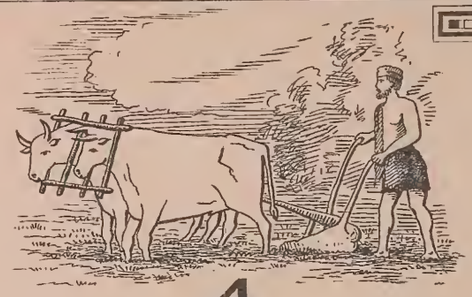
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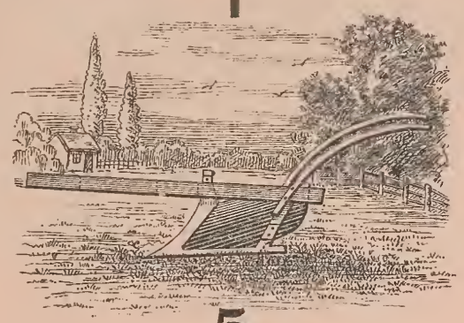
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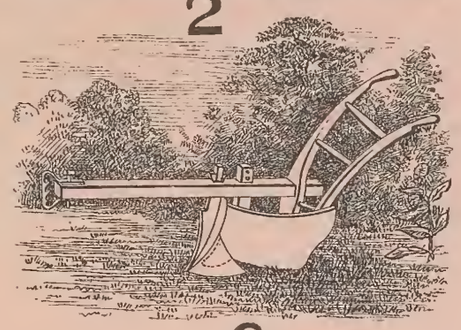
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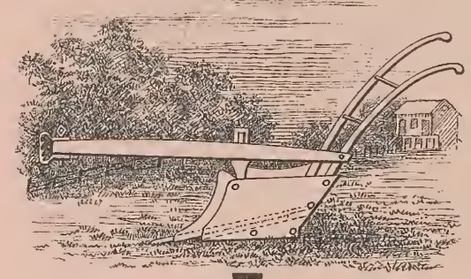
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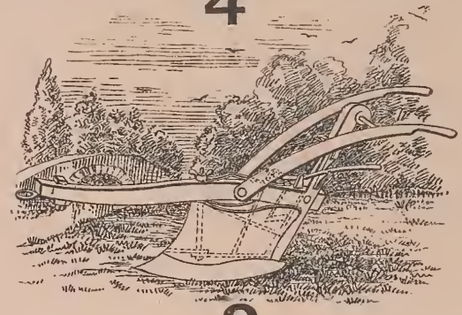
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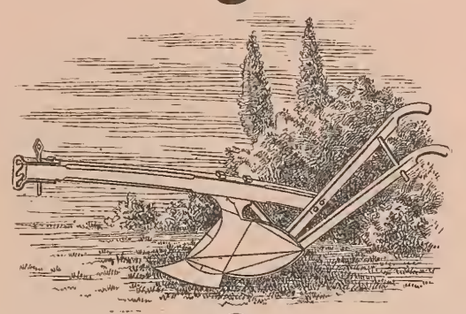
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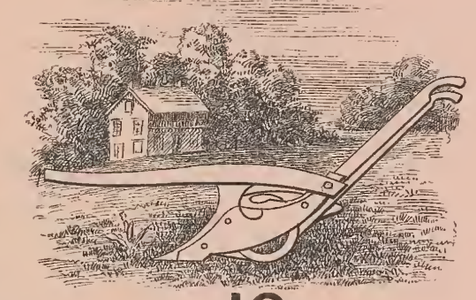
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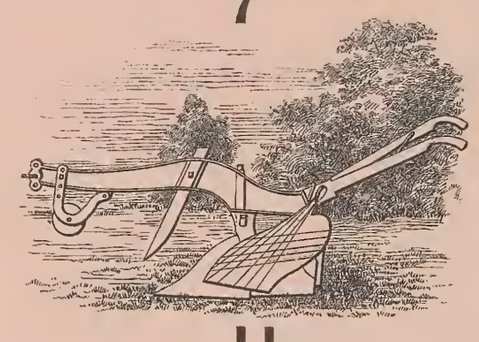
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PLOWS.

PLOWS.

No. 1. Primitive Egyptian.
2. " "
3. " "
4. " Assyrian.
5. U. S. Patent, Cast Iron—A. D. 1797.
6. " " Steel and Wrought Iron—A. D. 1808.
7. " " Adjustable Point—A. D. 1819.
8. " " Side Hill—A. D. 1831.
9. " " Colter Attachment—A. D. 1834.
10. " " Rolling Land Side—A. D. 1843.
11. " " Swivel Attachment—A. D. 1870.
12. " " Jointer " —A. D. 1884.
13. " " Wheel—A. D. 1884.
14. " " Gang—A. D. 1884.
15. " " Steam—A. D. 1884.

The use of the plow can be traced to a very remote antiquity. "The Book of Job," the most ancient writing of The Old Testament, begins with an allusion to the plow.

The first idea of the plow was a crooked stick, of which various forms were used; then came the provision of an iron point. Up to this time the crooked sticks were on the principle of the double mold board, thruwing off the earth on each side. The next step was to hew off one side of the sticks, so as to throw out the earth only on one side, approximating to a single mold board. Then the plow became a simple wedge, the land side being parallel with the line of the plow's motinn, the other side moving the furrow still to the right, but leaving the furrow standing on edge. Then the wedge was gradually twisted so as to regularly invert the furrow.

Thomas Jefferson was one of the earliest American laborers in the effort to perfect and simplify the plow, his first ideas on the subject having been noted in his journal of 1788, although it was not until 1793 that he reduced his theory to practice.

The next American inventor was Charles Newbold, of Burlington County, New Jersey, who invented and constructed the first cast iron plow in America, for which letters patent were granted to him on June 28, 1797. After expending large sums of money in perfecting and introducing his invention, he abandoned the business in despair. The farmers conceived the idea that the "cast iron plow" poisoned the land, injured its fertility and promoted the growth of weeds.

The second patent granted by the United States for a plow, was to John Deaver, of Maryland, June 12, 1804.

Third, to D. Peacock, of New Jersey, April, 1807.

Fourth, to S. Vinton, of Connecticut, November 18, 1807.

Fifth, to H. Harris, of Kentucky, February 24, 1808.

Sixth, to R. B. Chenoweth, of Maryland, November 25, 1808.

Patents on plows were subsequently issued in the following order:

October 12, 1809, F. Woodward, New York.
October 12, 1809, U. & J. Nichols, New York.
July 13, 1810, S. Hall, Massachusetts.
August 10, 1811, J. Sanford, Connecticut.
September 7, 1811, N. Turnbull, Maryland.
January 11, 1812, J. Klay, Maryland.
February 8, 1813, J. Seeley, Maryland.
May 28, 1813, S. Tously, New York.
June 2, 1813, M. Patrick, New York.
August 7, 1813, M. Murray, Maryland.
August 28, 1813, H. Pease, Connecticut.
March 1, 1814, J. & J. Butler, Pennsylvania.
July 2, 1814, Jethro Wood, New York.
July 5, 1814, J. Swan, New York.
October 14, 1814, Morgan & Harris, New York.
November 9, 1814, Tously & Swan, New York.
December 17, 1814, H. Shultz, Pennsylvania.
October 13, 1816, J. Cromwell, Virginia.
May 29, 1817, D. Peacock, New Jersey.
July 31, 1817, J. Lupton, Virginia.
May 26, 1818, G. Davis, Maryland.
October 26, 1818, P. Miller, New York.
December 19, 1818, R. M. Harrison, New York.
December 28, 1818, G. D. Avery, New York.

Eleven of these patents were issued to citizens of New York, eight to Maryland, three to Connecticut, two to Virginia, two to Pennsylvania, one to Kentucky, and one to New Jersey. After this time the inventors of plows multiplied so rapidly that only those are enumerated whose inventions involved new ideas, or such as have been remarkably popular, viz: Harris, 1819; Burden, 1819; Hingham, 1823; Hitchcock, 1823; Nourse, 1827; McCormick, 1831; Mears, 1831; Prouty, 1831; Jacobs, 1834; Webster, 1836; Webster, 1837; Witherow, 1839; Alger, 1839; Burrell, 1843; Holbrook, 1845; Mead, 1863.

Jefferson and Small discovered the importance of straight lines running from the sole to the top of the share and mold board; Pickering, the importance of a straight line running from the front to the rear; Jethro Wood, that all the lines running from the front to the rear should be straight; Knox, the method of laying down all the lines on a plane surface; Mears, the importance of a center draft, and the practical means of obtaining it by the inclination of the land inward.

Smith was the first to adopt two plows to work together, one of which threw two or three inches of the surface into the bottom of the preceding furrow, and the other covered it with the lower earth.

Gov. Holbrook invented a method by which plows of any size could be made symmetrical, either concave or convex, in such a way as to insure the complete pulverization of the soil.

It is strange, in view of the antiquity and importance of the plow, that its construction should have received so little attention from scientists, and that the principles of its construction should have been so little observed by those who used it.

There are, approximately, 900 establishments in the United States for the manufacture of plows, the annual product of which is estimated at $5,000,000.

The plowing of the land under cultivation in the United States is estimated at 180,000,000 acres, requiring the labor of 2,000,000 teams, either of oxen, horses or mules for 80 days each year.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,4 7,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed.	14,814	39,480

SUB CLASS.

PLOWS.

1,326,123 Manufactured in 1880.

Capacity—	Primitive Mods.	Present Machine.
Acres per day,	½	20
Hands Employed per day,	1	1

6,686 Patents Granted by the United States.

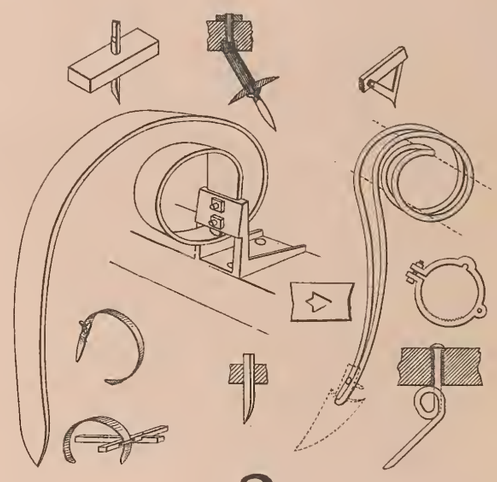
Sackett & Wilhelms Litho Co New York



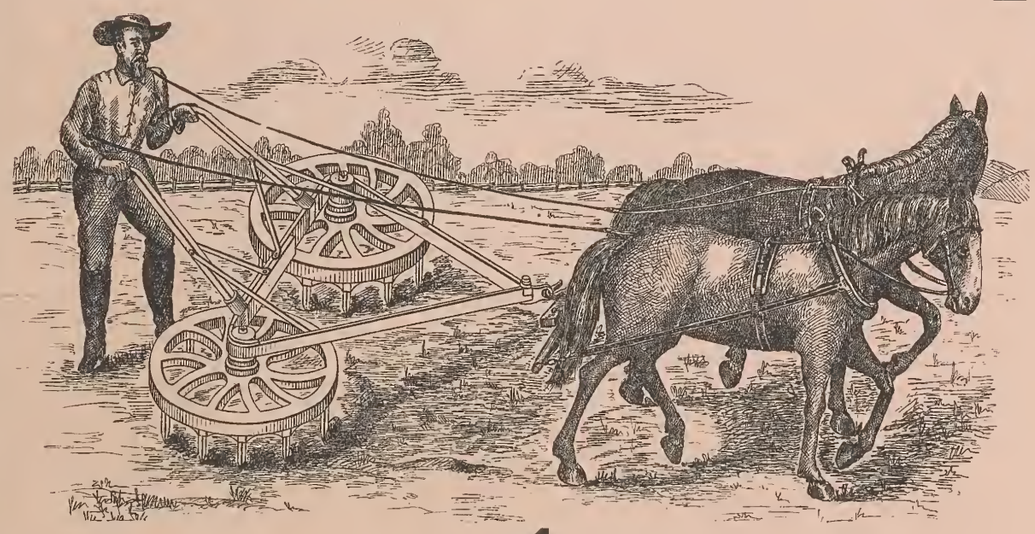
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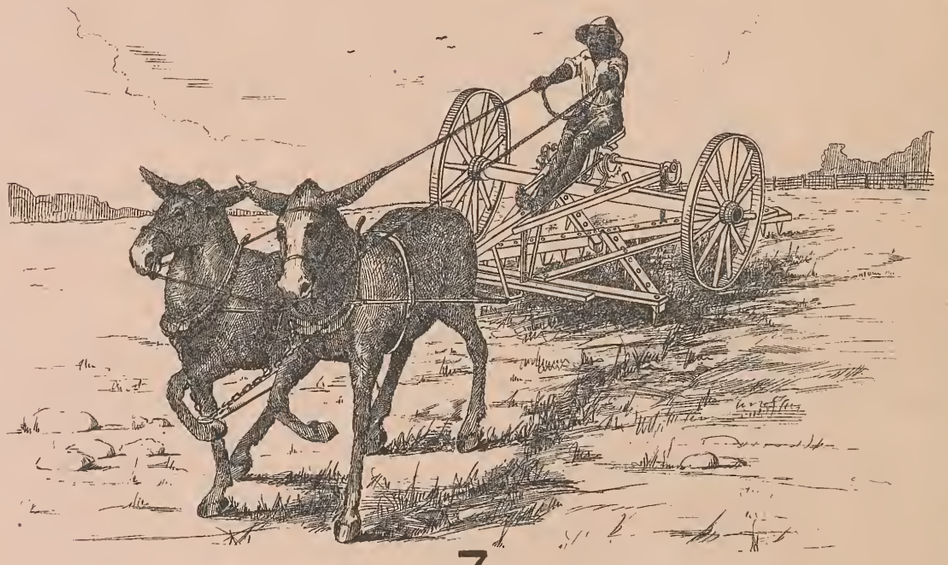
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HARROWS.

HARROWS.

No. 1. Primitive Hand.
2. " Log.
3. U. S. Patents, Types of Teeth.
4. U. S. Patent, Rotary—A. D. 1859.
5. " " Disk—A. D. 1867.
6. " " Spring Tooth—A. D. 1869.
7. " " Wheel—A. D. 1876.
8. " " Disk—A. D. 1877.
9. " " Crushing—A. D. 1882.
10. " " Wheel Spring Tooth—A. D. 1884.

The Harrow is mentioned three times in the Bible. First, in the book of Job, "Will he (the unicorn) harrow the valleys after thee." II Chronicles xx, 3, "He cut them with saws and with harrows of iron." In 2d Samuel, "He put them under saws and under harrows of iron."

The harrow was not in ordinary use in ancient Egypt. The various operations of husbandry at that period show that the clods of earth were either broken with hoes and plows, or by the tramping of men and animals.

Harrows bore the part in tilling the ground in the time of Pliny, A. D. 79, that they do at the present time: "after the seed is put into the ground, harrows with long teeth are drawn over it."

The harrow of the Romans was a hurdle. They also used planks studded with iron spikes.

There is a representation of a harrow in the tapestry of Bazeaux, A. D. 1066.

One of the old modes of using the harrow in Ireland was to tie, with a cord of raw hide or bark, the trunk or brush limb of a tree to a horse's tail. This was abolished by act of Parliament, in the year 1664, "as being cruel and injurious to the animals."

In some parts of the north of Europe, the spiked limbs of fir trees are bound together. The spurs of the limbs make a reasonably fair substitute for the teeth of a harrow.

The usual form of the British harrow is called the "Berwickshire."

Double harrows are made in many forms, two, three or four leaved, having sections square, lozenge shaped, trapezoidal, rhomboidal or triangular.

Rotary harrows are also made in various forms, and may have one, two or more sections, which lie flatly on the ground.

The spiked cylinder harrows are a late invention.

The spring harrow teeth, formed of spring metal, have been introduced, and are very extensively manufactured as a novel improvement in this line of inventions.

The concavo, convex and straight disk is one of the latest completed improvements.

Among the latest are those having inclined teeth set so, or set in bars susceptible of various inclinations.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

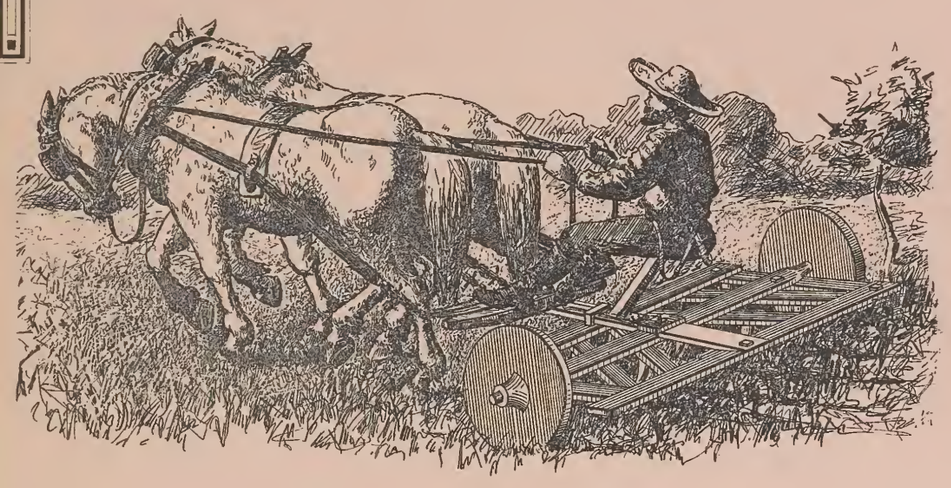
HARROWS.

127,997 Manufactured in 1880.

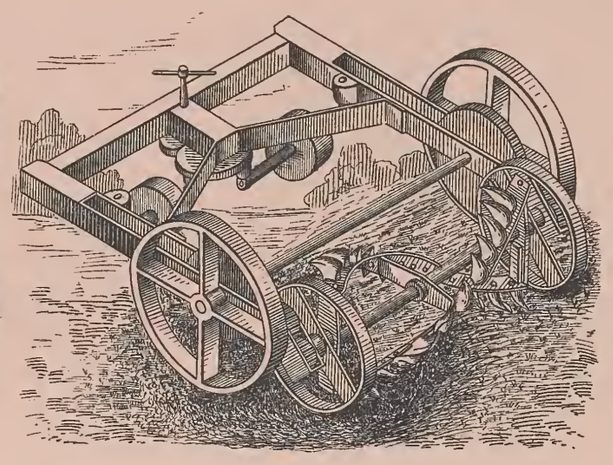
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1	30
Hands Employed per day,	1	1

1,478 Patents Granted by the United States.

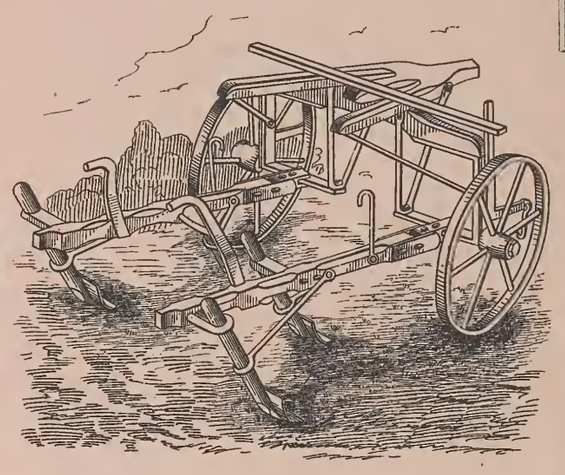
Sackett & Wilhelms Litho Co New York



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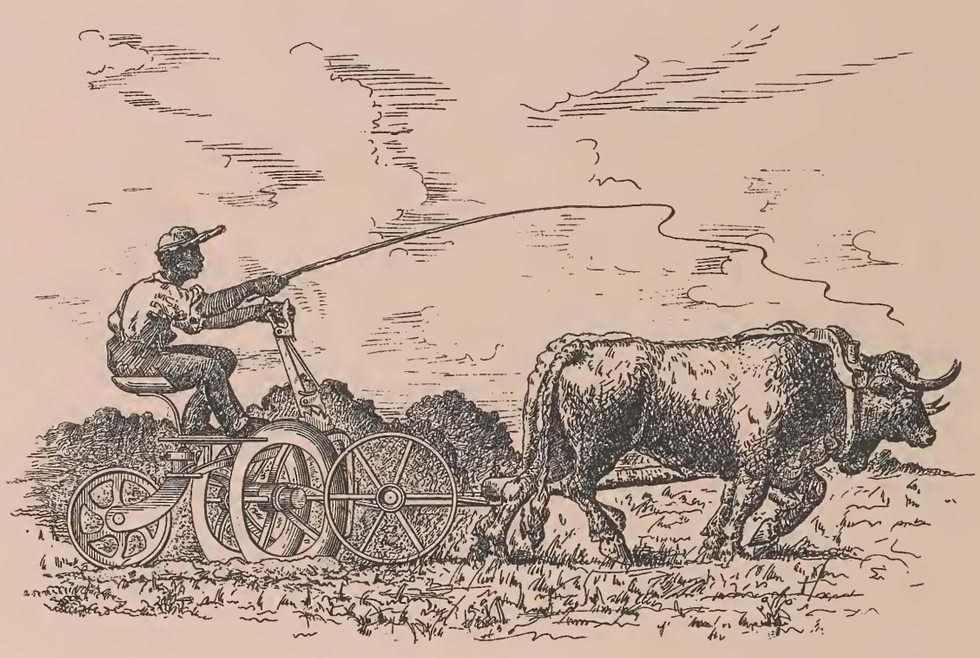
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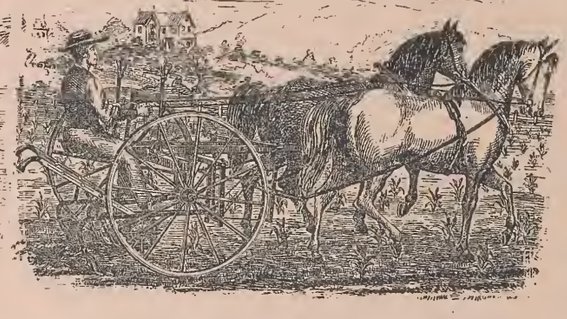
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CULTIVATORS.

CULTIVATORS.

No. 1. U. S. Patent, Wheel—A. D. 1846.
2. " " Rotary—A. D. 1858.
3. " " Straddle Row.—A. D. 1869.
4. " " Wheel Parallel—A. D. 1879.
5. " " Disk—A. D. 1880.
6. " " Spring Attachment—A. D. 1883.
7. " " " " —A. D. 1884.
8. " " Parallel, Riding—A. D. 1884.

Ancient Roman writers recommended hoeing and weeding the corn and fallowing the ground.

The progenitor of the cultivating machine is the hoe. History furnishes no account of a time when man was destitute of the hoe and the plow; in the distant past they were all of wood; the original hoe was a forked limb.

The term "cultivator" embraces implements which are used in tending growing crops; it is an improved harrow.

Jethro Tull, of England, is the author of horse-hoeing husbandry, and introduced his system, in 1701, of cultivating plants by machinery. In 1731 he published a book on this subject which rendered the invention of the cultivator possible.

Wilkie, of Scotland, is the inventor of the cultivator. He invented in 1820, the plurality of shares, the expanding frame and the caster wheel.

The Finlayson cultivator was used in England in 1826.

Cultivators are direct off-shoots from the regular plow.

The first patent granted by the United States for cultivators was to Borden, in 1830.

The first wheel cultivator patent was issued in 1846.

The single shovel plow has been in use for many years: the double shovel is a later invention: it resembles some of the plows used for a thousand years or more in Asia and Southern Europe. The double shovel is nearly perfect for the purpose for which it is used, viz: that of tending a crop which is planted in hills, such as corn or potatoes.

The nearest approach to the American shovel plow is the Scotch horse hoe.

The Scotch grubber is a heavy cultivator, drawn by four horses and supported on wheels, for stirring and loosening the soil to plow depth.

Cultivators are classed in the United States as ordinary, wheeled, rotary, straddle-row, parallel, disk, walking, riding, vineyard and expanding.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
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Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

CULTIVATORS

318,057 Manufactured in 1880.

Capacity—	Prim'tive Mods.	Present Machines.
Acres per day,	1	10
Hands Employed per day,	1	1

2,554 Patents Granted by the United States.

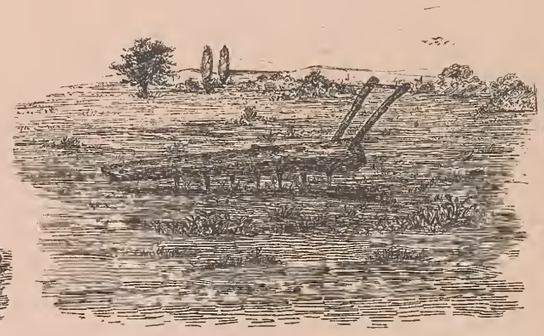
Sackett & Wilhelms Litho Co New York



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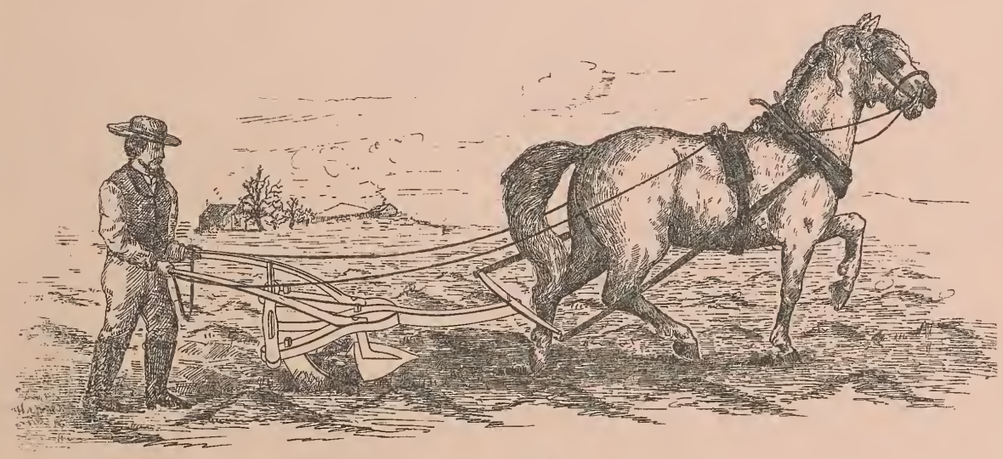
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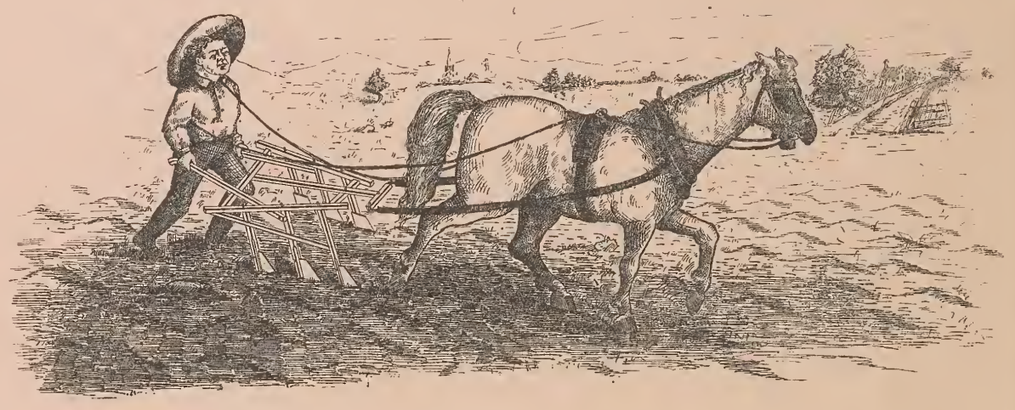
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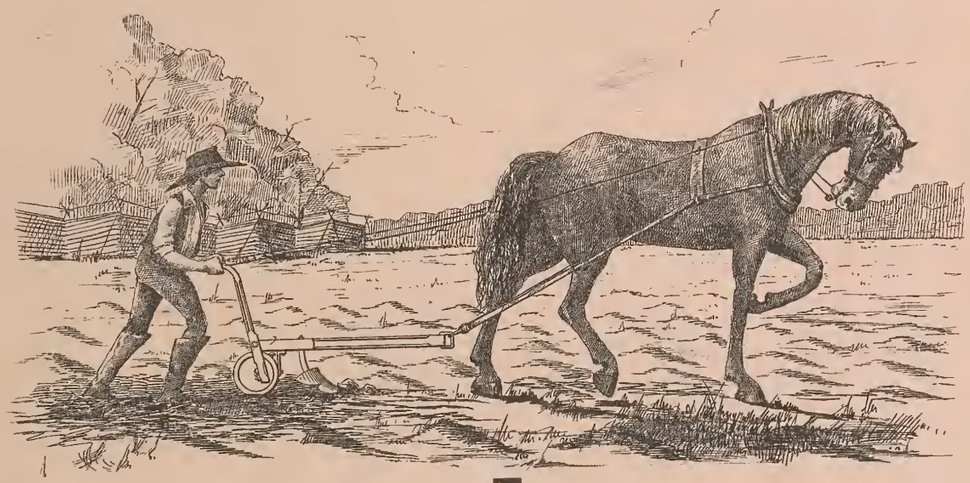
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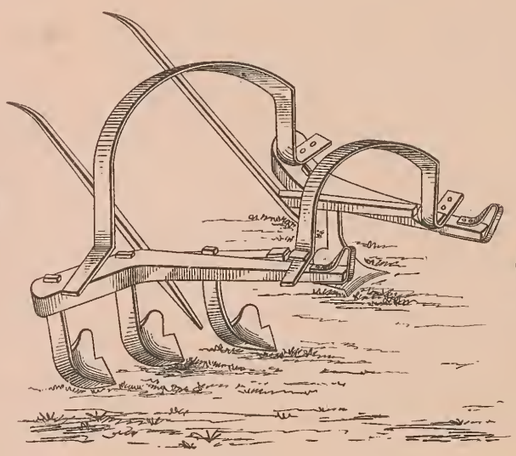
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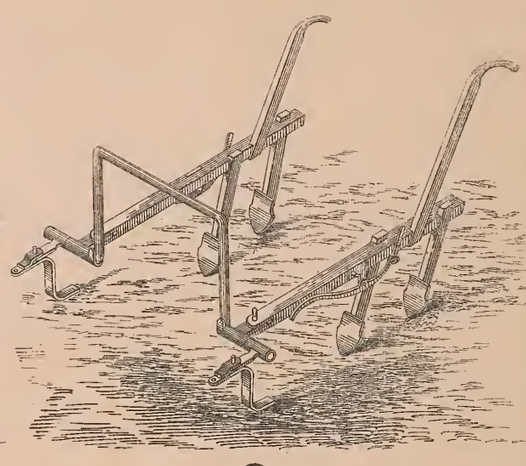
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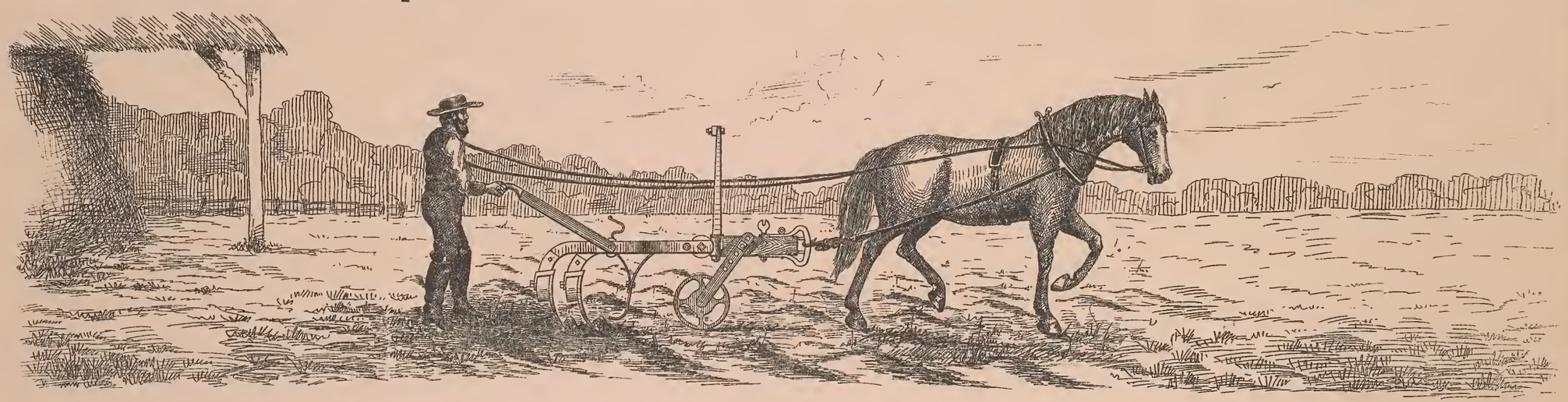
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CULTIVATORS--WALKING.

CULTIVATORS—WALKING.

No. 1. Primitive Crotched Stick.
2. " Egyptian.
3. " Roman.
4. " English.
5. U. S. Patent, Hilling—A. D. 1830.
6. " " Straddle Row—A. D. 1835.
7. " " Hilling--A. D. 1837.
8. " " Parallel—A. D. 1851.
9. " " " Runner—A. D. 1884.
10. " " Straddle Row—A. D. 1884.

The walking cultivator is of modern invention, and is one in which the operator walks behind, as distinguished from the riding cultivator.

Many American cultivators are constructed with triangular or rectangular frames, with handles like those of a plow, with a greater or less number of teeth, and with their center beams projecting in front for the attachment of wheels and draft clevises.

They are very extensively manufactured and used in the United States, and are frequently called "horse hoes."

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

CULTIVATORS—WALKING.

318,057 Manufactured in 1880.

Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1	10
Hands Employed per day,	1	1

772 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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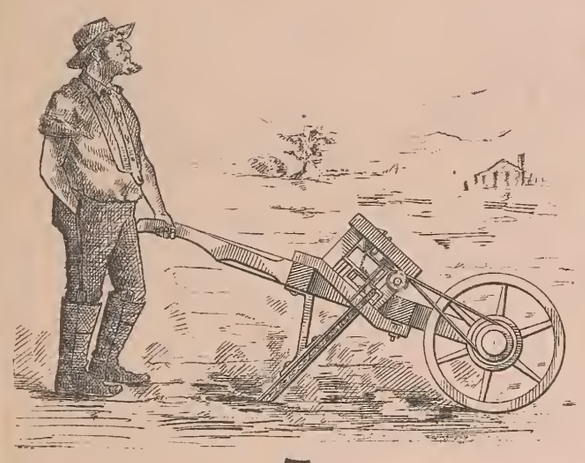
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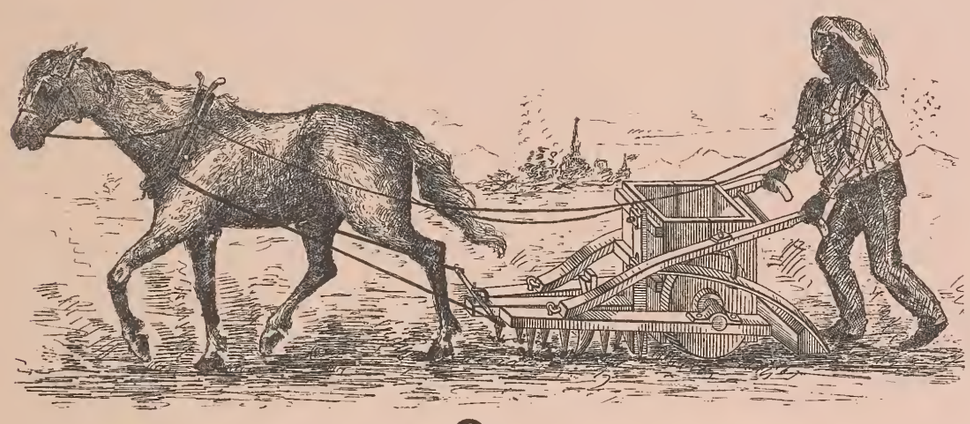
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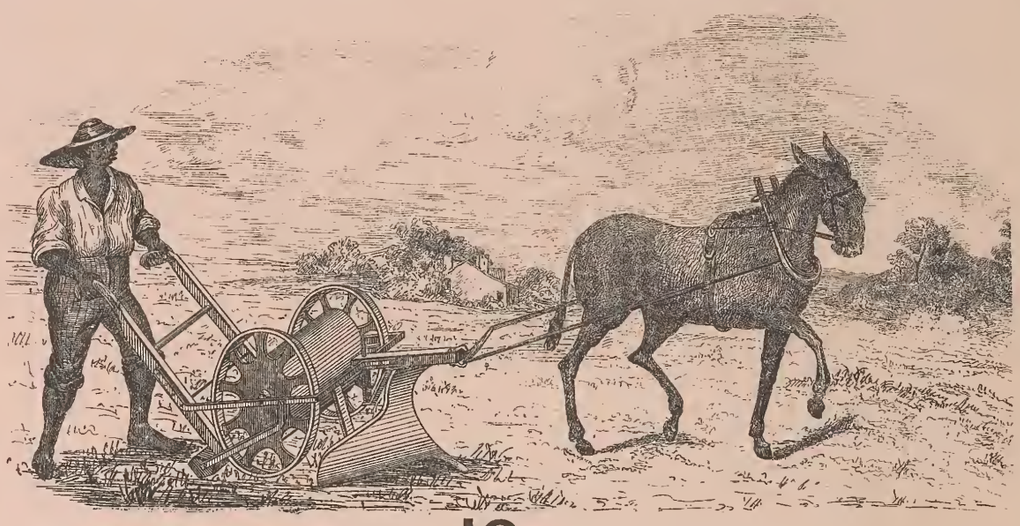
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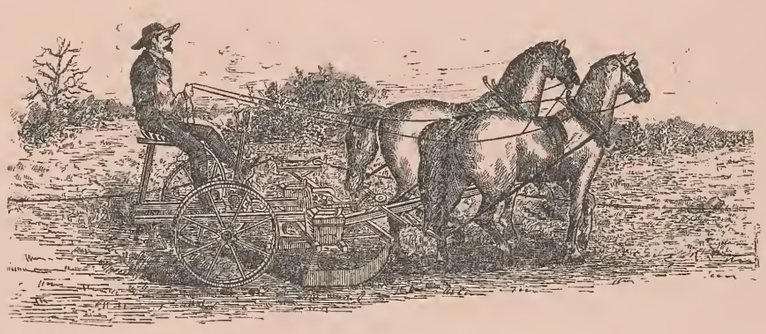
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11

PLANTERS.

PLANTERS.

No. 1. Primitive Hand.
2. " Dibbler.
3. " "
4. Modern Hand.
5. U. S. Patent Wheelbarrow—A. D. 1825.
6. " " Hand—A. D. 1856.
7. " " Foot—A. D. 1856.
8. " " Hand—A. D. 1876.
9. " " Cotton—A. D. 1876.
10. " " " —A. D. 1883.
11. " " Check Row—A. D. 1883.

Pliny says the Romans sowed their corn with as much care as they raised their armies.

Columbus found the natives of the West Indies using bread of maize.

Humboldt says that the cultivation of maize was introduced into Mexico in 666 by the Toltecs.

When Capt. John Smith visited Virginia in 1609, in writing of the Indians, he says: "The greatest labor they take is in planting corn."

About 1649 Gabriel Platte described a dibbling machine, formed of iron pins "made to play up and down like virginal jacks."

The Jesuit Lana, about the year 1665, proposed a planting machine to consist of a harrow, the spikes of which should make holes in the earth and the grains of corn were to fall from a box pierced like a sieve and placed over the harrow.

One of the first patents granted by the United States for a corn planter was a box that was placed on the shank of a hoe.

Planters are classified in the U. S. Patent Office as follows:

Corn, Cotton, Foot, Hand, Hand Oscillating, Hand Reciprocating, Hand Rotating, Potato, Potato Walking, Walking, Walking Vibrating Hoppers.

In the States which produce the greatest quantity of corn the larger part is planted by machinery.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

PLANTERS.

87,979 Machines Manufactured in 1880.

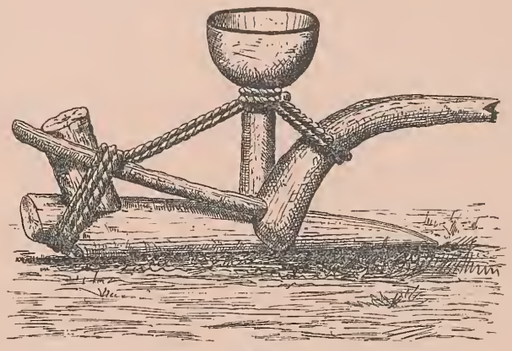
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	2	12
Hands Employed per day,	1	1

2,497 Patents Granted by the United States.

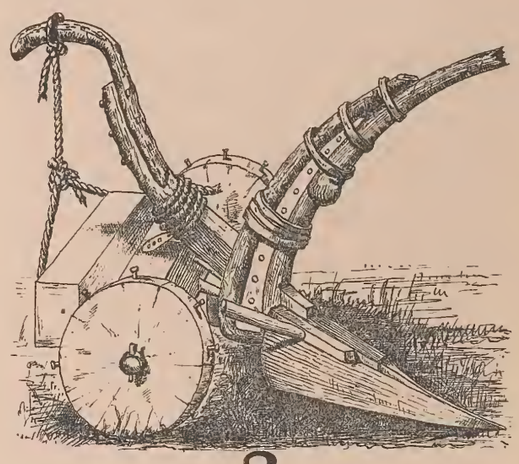
Sackett & Wilhelms Litho Co New York



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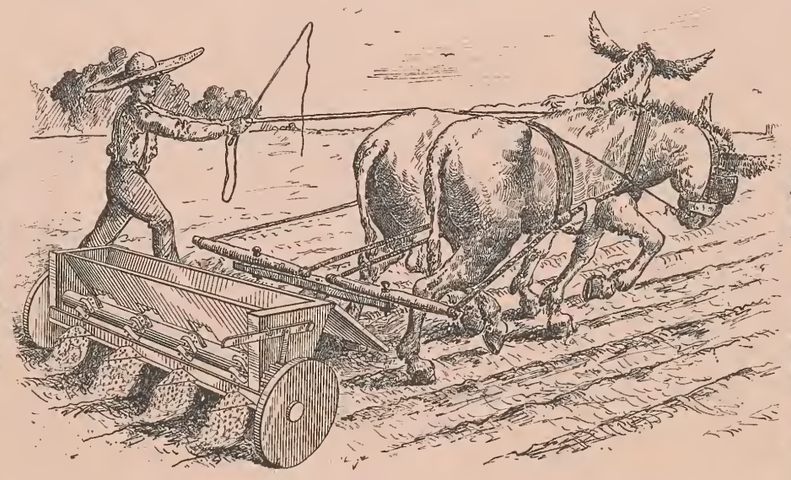
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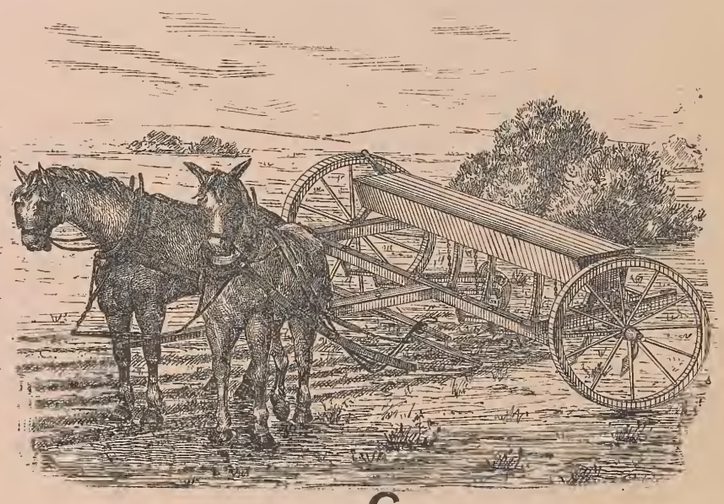
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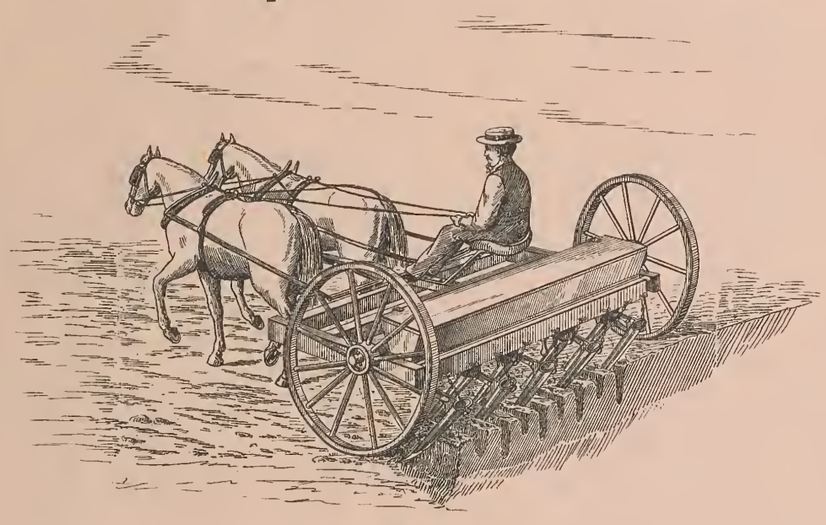
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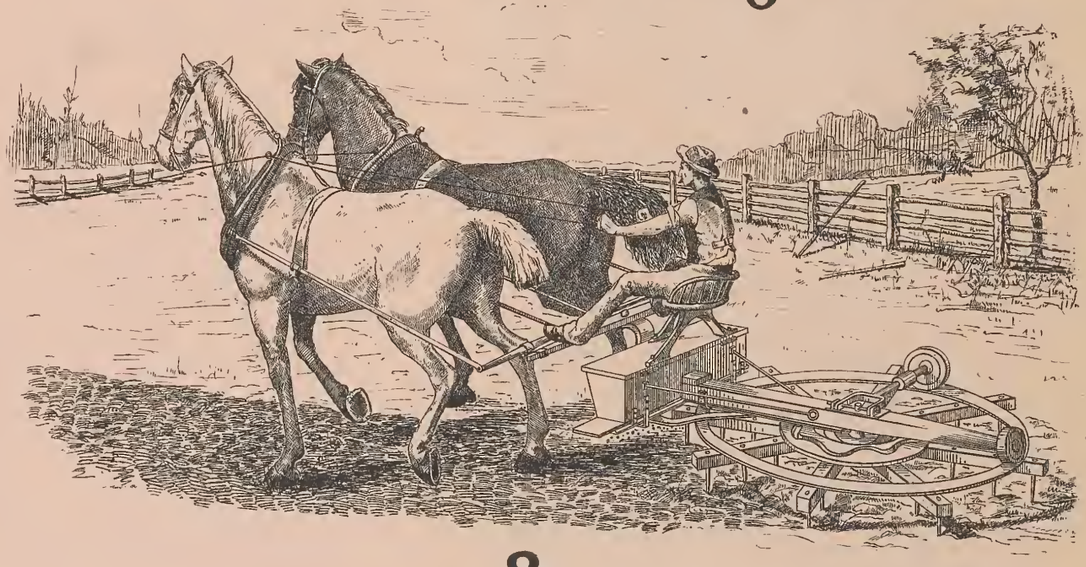
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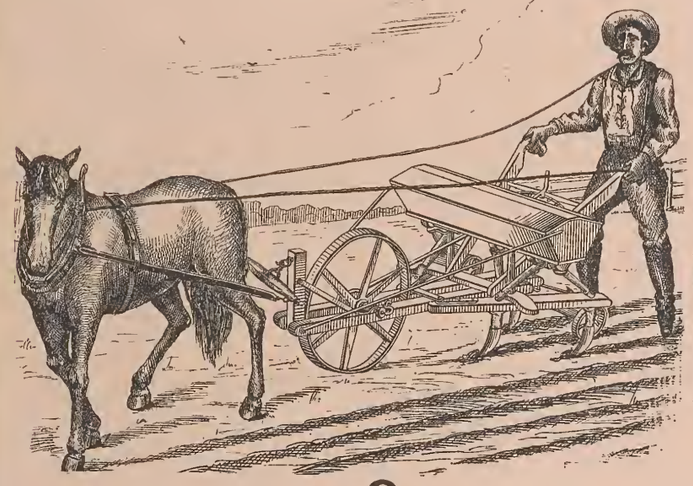
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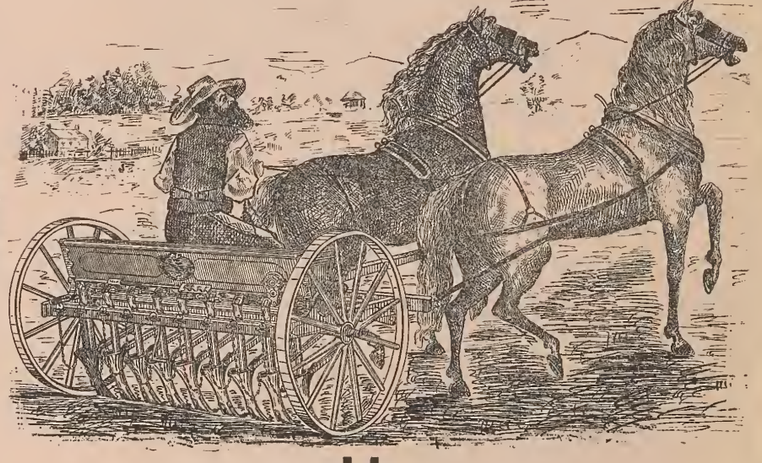
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SEEDERS.

SEEDERS.

No. 1. Primitive Egyptian.
2. " Assyrian—B. C. 504.
3. " Italian—A. D. 1605.
4. U. S. Patent, Slide Broadcast—A. D. 1835.
5. " " Rotary Broadcast—A. D. 1856.
6. " " Broadcast Cultivator Attachment—A. D. 1869.
7. " " Grain Drill—A. D. 1874.
8. " " Broadcast Harrow Attachment—A. D. 1878.
9. " " Walking Drill—A. D. 1881.
10. " " Grain " —A. D. 1884.
11. " " " " —A. D. 1884.

Seeding in ancient Egypt was done by scattering the seed upon the mud left after the receding waters of the Nile. The husbandman who scattered it was followed by a flock of sheep or goats, whose feet trod the seed into the surface of the soil.

The first seeding machine is said to have been used by the Assyrians, 504 B. C., and was called a drill plow.

The Italians claim the honor of originating, in 1605, the first seeder.

In the year 1623, Alexander Hamilton, of England, was granted a license for his protection in developing his invention of a seeding machine.

In 1634, David Ramsey made an attempt in the same direction, but without success.

Joseph Locatelli, of Austria, was the next to enter the field with a seeder. The exact date of the invention cannot be determined, but there is evidence that a trial of the machine took place at Luxembourg, in 1662. He obtained a patent for it in Spain. It was held in such high esteem that the Earl of Sandwich sent it to England.

In 1730, the attention of Jethro Tull, the inventor of horse-hoeing, was called to this machine, who was delighted with its adaptability to his mode of cultivation.

The first patent granted by the United States for a seeder was to E. Spooner, of Vermont, January 25, 1799. Hornsby, of England, was the first to apply india rubber tubes as grain spouts, in place of tin cups.

The American grain drill is usually drawn by a pair of horses, and has a gang of shares, in one or two banks. Some varieties have a capacity for changing to a single or double bank drill.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,840,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

SEEDERS.

79,074 Manufactured in 1880.

Capacity—	Primitive Mode.	Present Machine.
Acres per day,	3 to 5	10 to 20
Hands Employed per day,	1	1

1,440 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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DIGGERS.

DIGGERS.

No. 1. Primitive Hand.
2. " Egyptian Hoe.
3. " Chinese Spade.
4. U. S. Patent, Hand Potato Digger—A. D. 1856.
5. " " Digging Hoe—A. D. 1871.
6. " " Separating Digger—A. D. 1876.
7. " " Vibrating " —A. D. 1882.
8. " " Rotary " —A. D. 1882.

The spade as a digging instrument does not seem to have been known in Ancient Egypt; its place was supplied by a heavy hoe.

The Ancient Greek spade has two cross pieces for the foot.

The Irish spade has a single cross piece for use with the right foot.

Many attempts to devise a machine which shall plow up potatoes from the furrow, separate them from the loose earth and deposit them on the surface of the ground, have been made.

The modern potato digger is a machine drawn by horses, which digs the potatoes, separates them from the dirt, and loads them into a cart, whilst the farmer rides on the machine with nothing to do but to guide his team.

Diggers operated by steam take out 800 barrels of potatoes per day.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

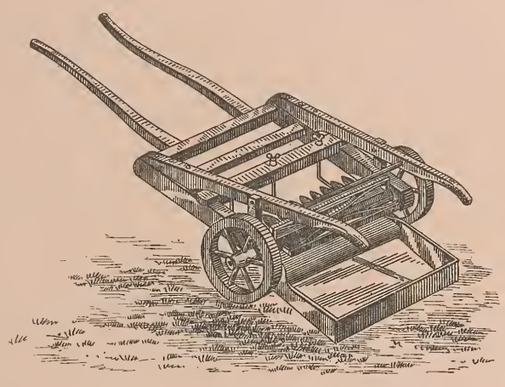
DIGGERS.

33,453 Potato Diggers Manufactured in 1880.

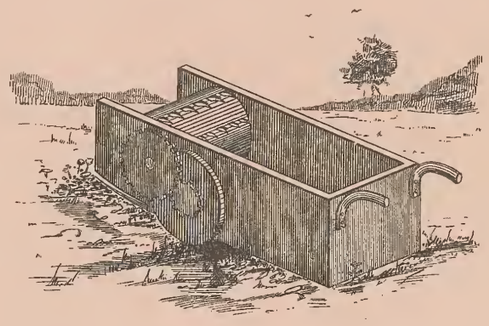
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	¼	10
Hands Employed per day,	1	1

952 Patents Granted by the United States.

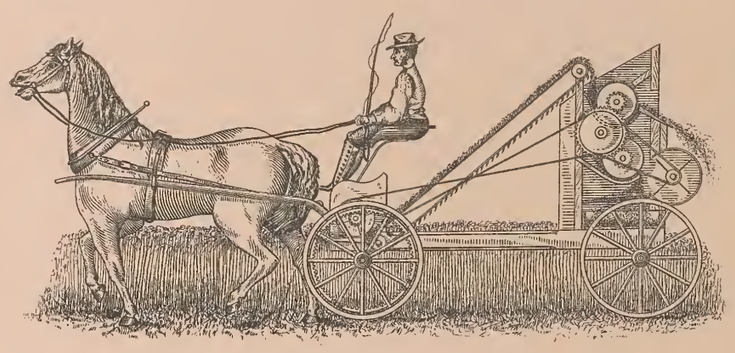
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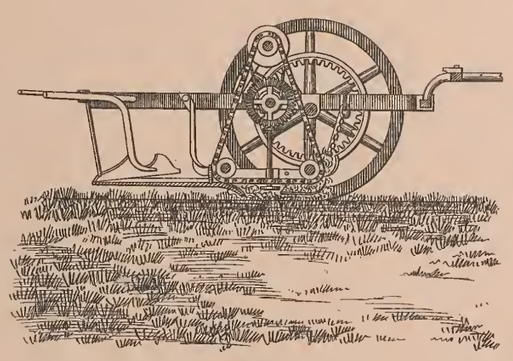
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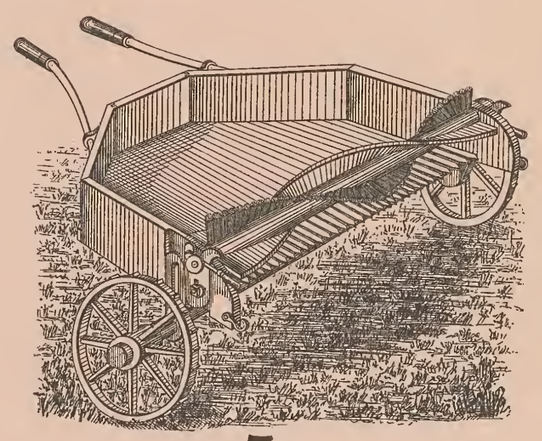
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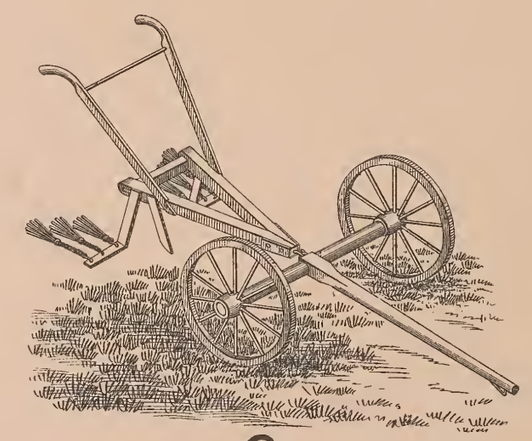
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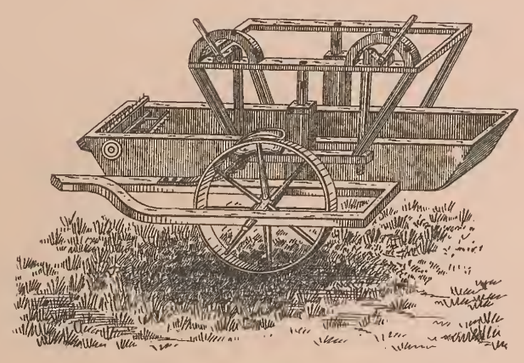
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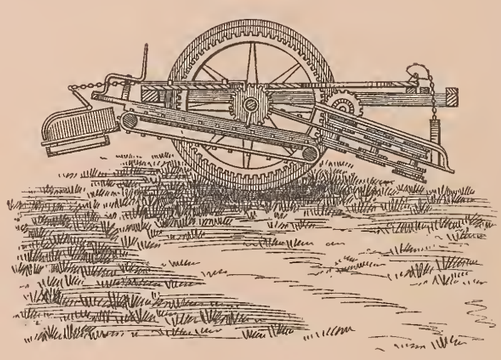
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BEAN AND CLOVER HARVESTERS.

BEAN AND CLOVER HARVESTERS.

No. 1. U. S. Patent, Clover—A. D. 1849.
2. " " Clover Stripping Drum—A. D. 1854.
3. " " Clover Head Cutter and Breaker—A. D. 1856.
4. " " Bean Stalk Cutter and Bundler—A. D. 1859.
5. " " Clover Spiral Drum—A. D. 1861.
6. " " Bean Underground Cutter—A. D. 1865.
7. " " Clover Head Stripper—A. D. 1877.
8. " " Bean Stalk Puller—A. D. 1879.

There are several forms of bean harvesters:

1. The hand puller, having a long row of teeth to catch, and a movable clamp which comes down upon the teeth to grip, the vines.

2. A machine with a broad, flat, oblique share, which cuts the roots beneath the surface, followed by lifting bars which raise, and a rake which collects, the vines in a bunch. By oscillating the rake the bunch is dumped upon the ground.

3. A plow, which cuts the vines below the surface, and lifting and directing rods, which conduct them to a box on the machine.

4. A machine with a pair of horizontal toothed wheels rotating in apposition, so as to grasp the vines at the ground surface, and lift them so that they may be grasped by a traveling elevator belt, which deposits them in a box of the machine.

5. A wheeled machine, in which the pulleys are guided in and out of a hollow cylinder by a cam guide, so as to catch the haulm, lift it and carry it upward and over, and then, by retroaction of the puller arms, leave the vines upon the platform. The pullers rest upon springs, and are projected by the same in the interval of their retraction by the cam guide.

Clover harvesters are constructed on the same principle as the wheat harvester of ancient Gaul. In this machine it was the duty of the attendant to sweep the ears of grain back into the box of the machine, which was driven before the ox that impelled it.

The English clover harvester of thirty years back was of the Gallic pattern, and was drawn by one horse and guided by handles in the rear. The load was scraped out occasionally, and deposited in bunches in the field.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

BEAN HARVESTERS.

Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1½	10
Hands Employed per day,	1	1

22 Patents Granted by the United States.

SUB CLASS.

CLOVER HARVESTERS.

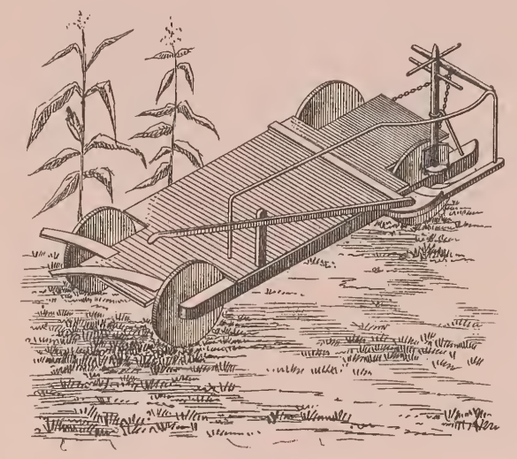
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1½	20
Hands employed per day,	1	1

44 Patents Granted by the United States.

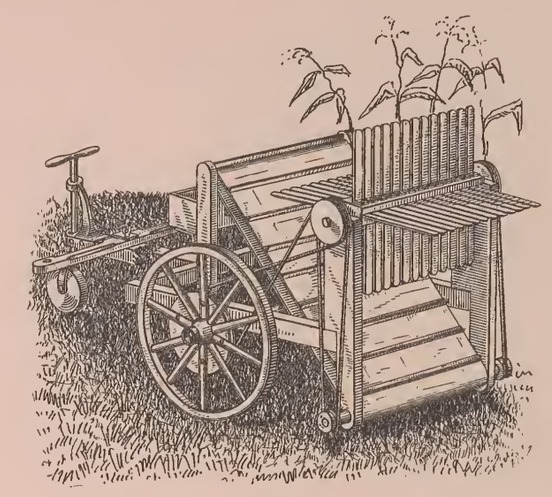
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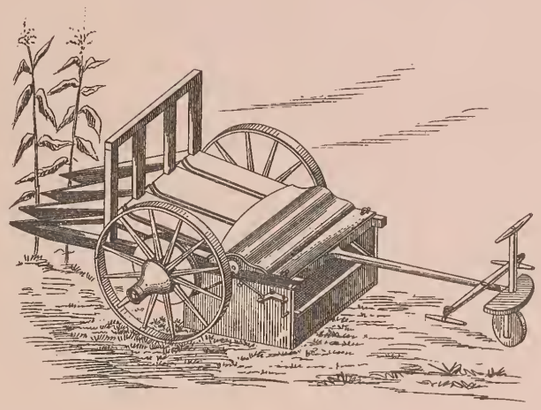
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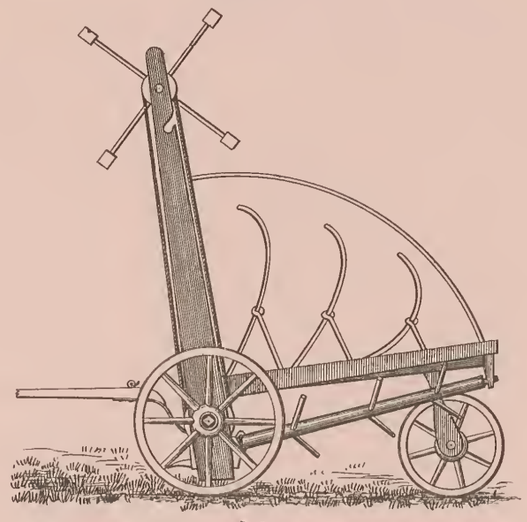
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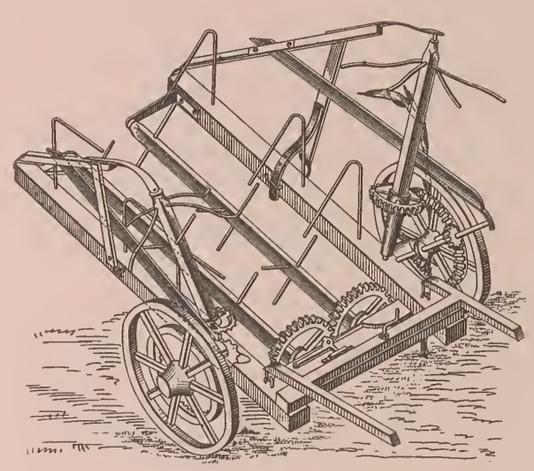
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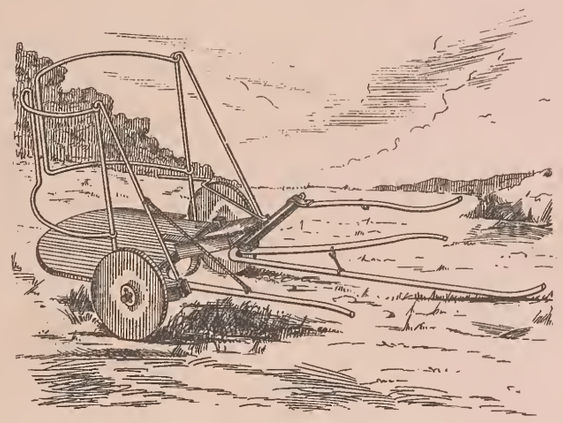
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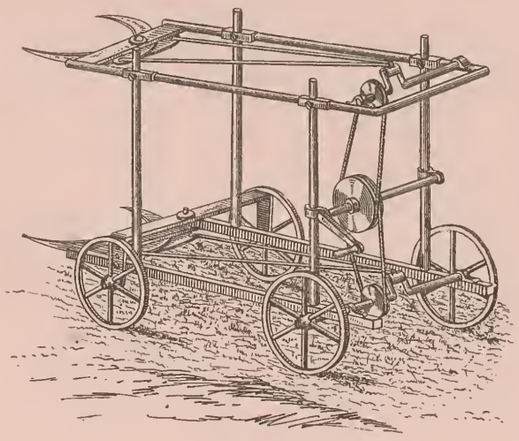
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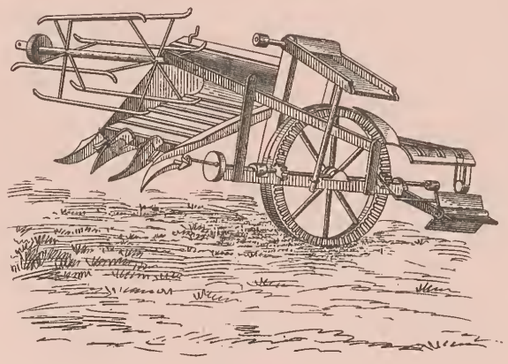
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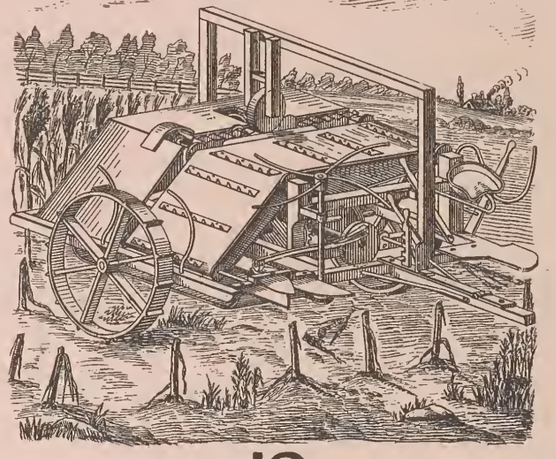
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12

CORN HARVESTERS.

CORN HARVESTERS.

No. 1. Primitive.
2. U. S. Patent, Cutter—A. D. 1844.
3. " " Ear Stripper—A. D. 1850.
4. " " Ear Stripper, Husker and Sheller—A. D. 1850.
5. " " Cutter and Shocker—A. D. 1852.
6. " " " " —A. D. 1854.
7. " " " " —A. D. 1856.
8. " " High and Low Cutter—A. D. 1859.
9. " " Cutter and Shocker—A. D. 1866.
10. " " Picker and Husker—A. D. 1867.
11. " " Picker, Husker and Shocker—A. D. 1869.
12. " " Cutter, Husker and Shocker—A. D. 1875.

The Romans cut their corn by hand, either close to the ground, with a hook, or only the ears, with a curved stick having a saw attached to it, or they cut the stalks in the middle, leaving the stubble to be afterwards mowed.

The modern corn harvester is a machine for cutting corn in the field; sometimes delivering the corn in shocks, sometimes merely laying it in gavels upon the ground, or on the machine, whence it is taken by hand and shocked.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

CORN HARVESTERS.

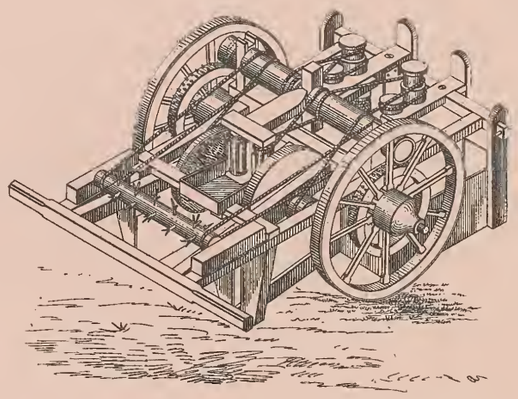
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1½	10
Hands Employed per day,	1	1

286 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



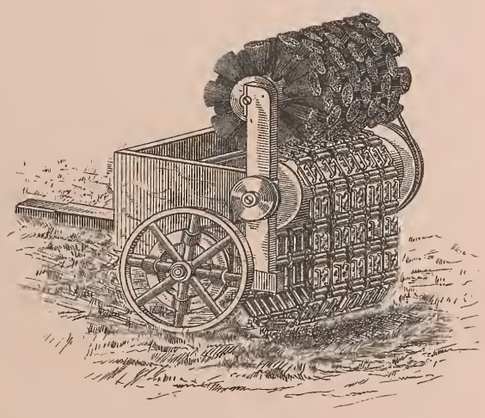
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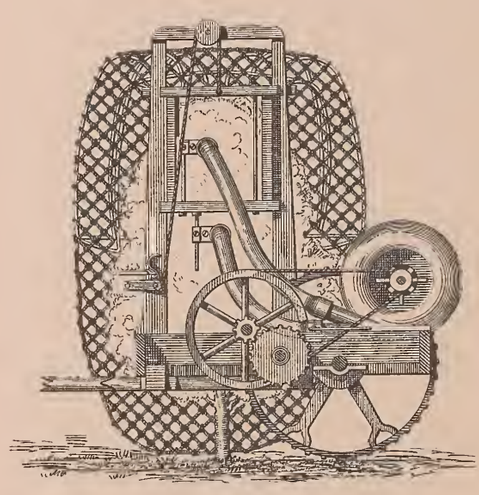
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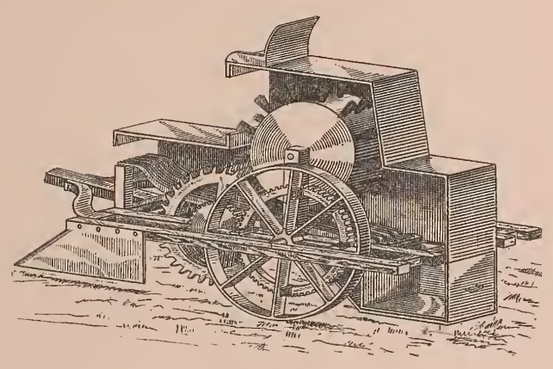
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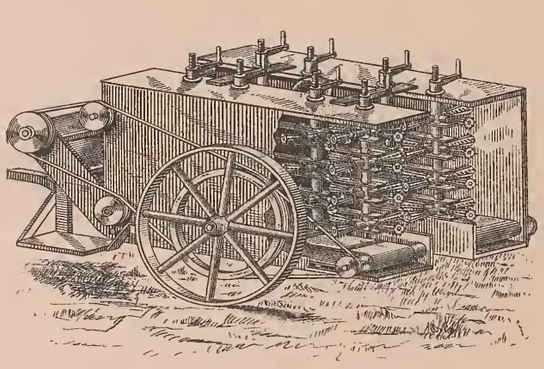
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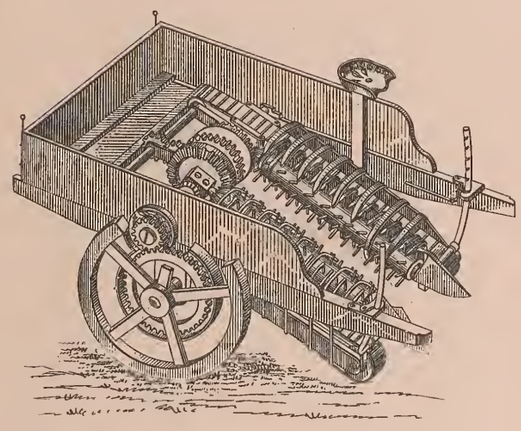
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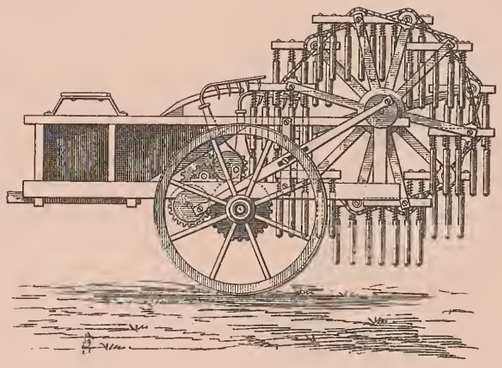
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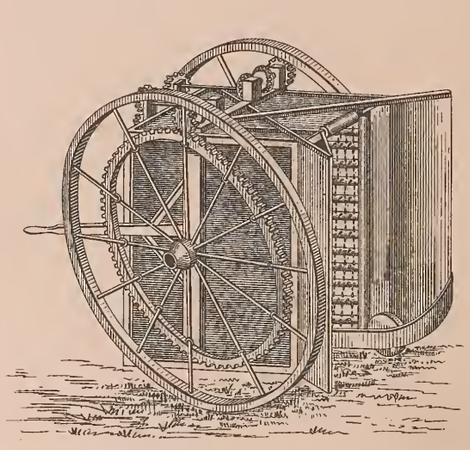
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12

COTTON HARVESTERS.

COTTON HARVESTERS.

1. Primitive Hand.
2. U. S. Patent, Toothed Picking Disks & Cylinders—A. D. 1850.
3. " " Hand Picker—A. D. 1855.
4. " " Brush Stripper—A. D. 1859.
5. " " Exhaust Flexible Pipe—A. D. 1859.
6. " " Fan Blower—A. D. 1868.
7. " " Saw and Stripper Brush—A. D. 1870.
8. " " Electric Belt—A. D. 1870.
9. " " Picker Stem—A. D. 1872.
10. " " Toothed Cylinder—A. D. 1874.
11. " " Revolving Picker Stems—A. D. 1878.
12. " ". Toothed Cylinder—A. D. 1883.

The season for harvesting cotton in the United States begins in August, and continues until November, and sometimes even until the latter part of December.

The cotton plant continues to produce and ripen its bolls until the appearance of frost. The height of the picking season is in October.

Harvesting by hand is generally performed by negroes, both male and female, who, with wide-mouthed sacks suspended from their waists, pass between the rows of plants and gather the fleecy cotton from the open pods, when it is carried in the sacks and deposited in baskets at the end of the rows; the average amount per person picked per day being from 200 to 300 pounds.

The primitive mode of harvesting is the most general.

AGRICULTURAL IMPLEMENTS:

1,943 Manufactories in the United States.

	1860	1880
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Value of Productions,	17.599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

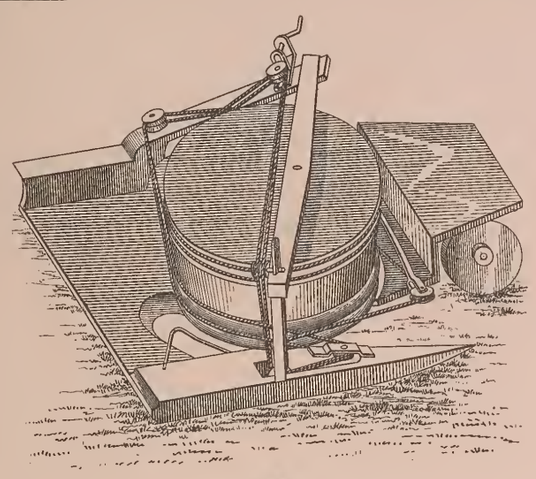
SUB CLASS.

COTTON HARVESTERS.

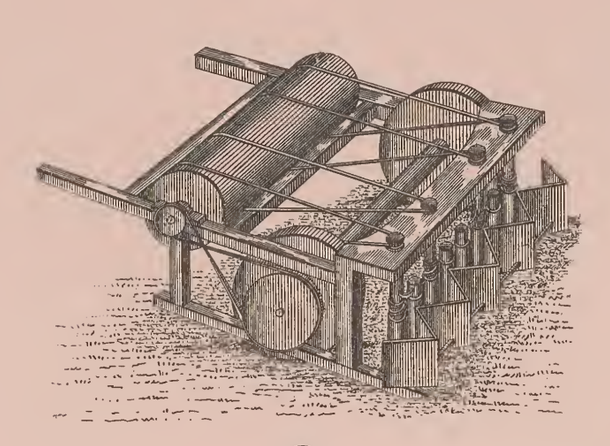
Capacity—	Picked by Primitive Mode.	Gathered by Present Machine.
Pounds per day,	300	1,500
Hands Employed per day,	1	1

104 Patents Granted by the United States.

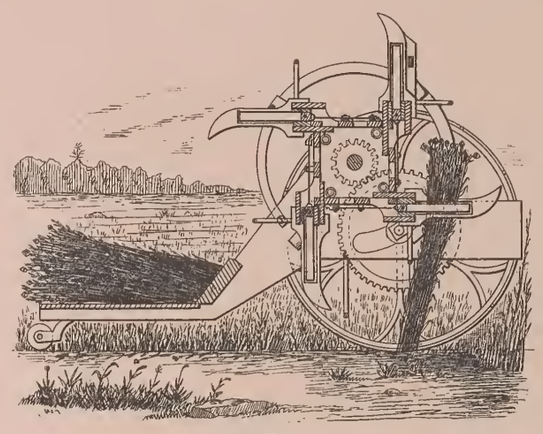
Sackett & Wilhelms Litho Co New York



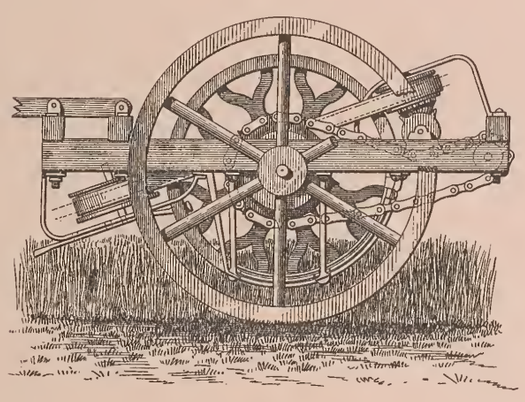
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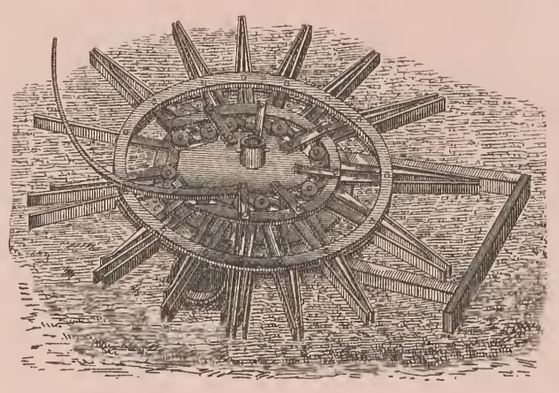
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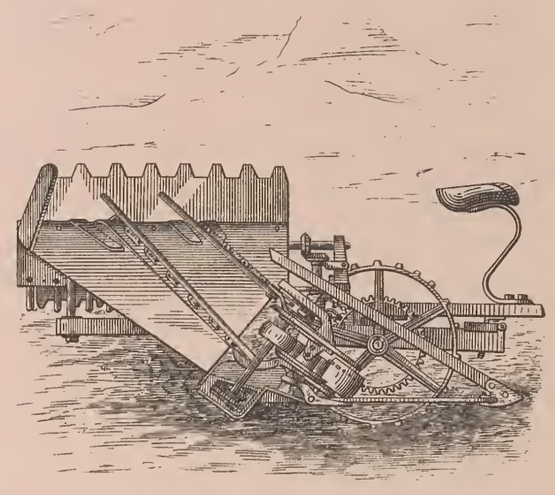
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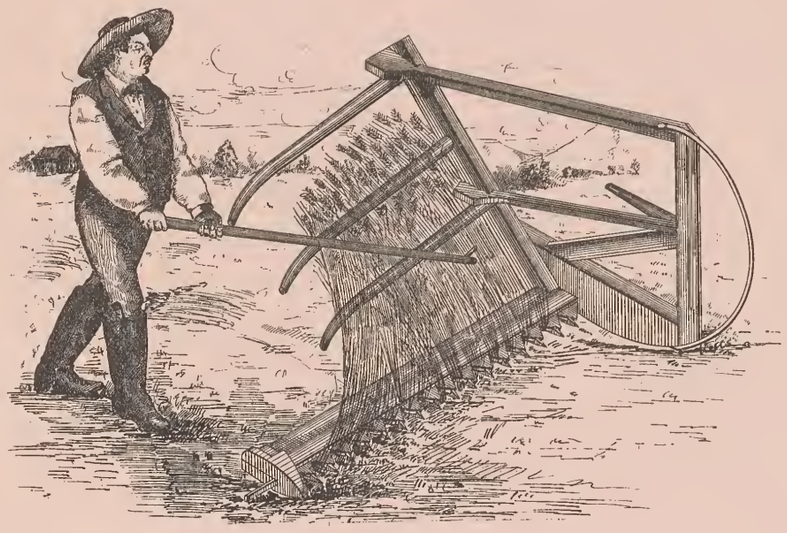
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HEMP AND FLAX HARVESTERS.

HEMP AND FLAX HARVESTERS.

No. 1. U. S. Patent, Revolving Pulling Drum & Band—A. D. 1838.
2. " " " Pulling Roller—A. D. 1852.
3. " " Reciprocating Pulling Jaw—A. D. 1863.
4. " " Stalk Puller—A. D. 1866.
5. " " Side Delivery—A. D. 1870.
6. " " " —A. D. 1871.
7. " " Stalk Cutter—A. D. 1872.

Hemp and flax harvesters are reaping machines resembling those for corn in their adaptation to operate upon tall top-heavy stalks, and differ from them in cutting low. One form is a puller, which grasps the stalks near the ground and uproots them. Another variety is one with a low platform on wheels, with a cutter bar in front, a reel to gather the stalks to the knives and direct them over into a cradle where they are collected in a bunch. In another form the stalks are caught by an arm till a shock is collected.

The stalk puller consists of a pair of revolving disks on axes, set at an obtuse angle with each other, so as to grip the stalks, which are conducted between them at the lowest part of their revolution, and then open as they rotate, and allow the stalks to fall into a cradle on the ground.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
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Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

HEMP AND FLAX HARVESTERS.

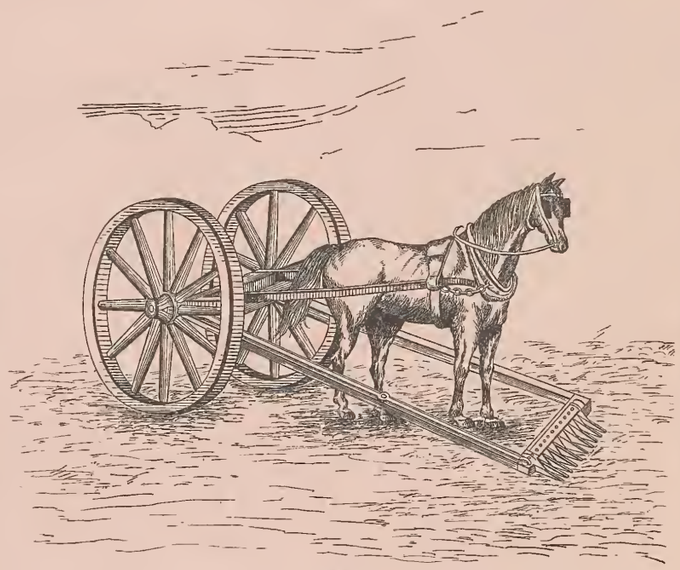
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1½	10
Hands Employed per day,	1	1

36 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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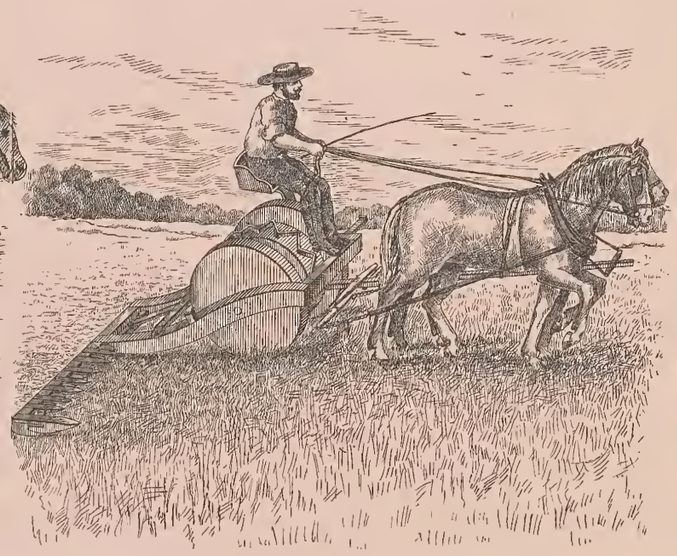
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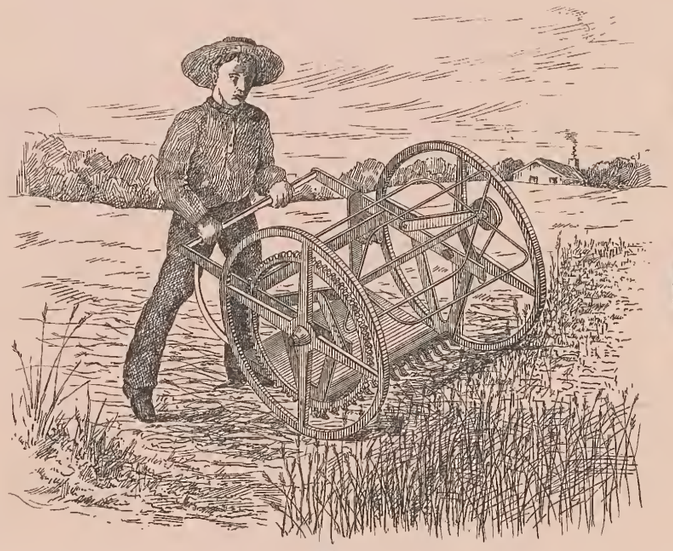
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HARVESTER CUTTING APPARATUS.

HARVESTER CUTTING APPARATUS.

1. Primitive Grass Hook.
2. U. S. Patent, Reciprocating Serrated Cutter—A. D. 1851.
3. " " 2 Cutters reciprocating in opposite directions—A. D. 1850.
4. " " Endless Chain Cutter—A. D. 1855.
5. " " Wave Wheel Reciprocating Cutter—A. D. 1855.
6. " " Rotary Cutters—A. D. 1856.
7. " " Vibrating Cutters—A. D. 1856.
8. " " Spiral Cutters—A. D. 1857.
9. " " Differential Gear Gyrating Motion—A. D. 1870.

Far back in the history of art "Time" himself is represented as a winged old man with a primitive scythe in his hand.

A charming harvest scene is presented to us in the Bible, when the loyal-hearted Ruth bends above the golden sheaves cut down by the scythes of the laborers of Boaz. This scene has been the theme of song and story since the time that the chivalrous son of Judah lifted the beautiful daughter of Moab, from among the humble gleaners in the field, to be the mistress of his heart and home. It has been reproduced in stained glass in our church windows, painted on the artist's canvas, and retained in the picture gallery of the mind by every one who ever read the pathetic narrative told in the brief Book of Ruth.

The scythe of the present day is of Anglo-Saxon origin, and was first spelled "sithe."

In ancient days a scythe was affixed to the axles of war chariots, intended, like that held by "Time," to mow down men instead of grain.

With the advancement of civilization, however, this useful apparatus became associated solely with the peaceful implements of agriculture, and has even furnished a convenient rhyme for the poets in their pastoral songs and gentler epics. For instance, even Puritan John Milton sings:

"While the milkmaid singeth blythe
And the mower whets his scythe."

Man has hammered at the problem of finding the most convenient and available machine for harvesting for centuries.

The harvester used in the plains of Rhætia, in the time of Pliny, had no proper motion, but was simply a comb whose teeth had sharp edges which tore and cut the head of the grain from the stalk and allowed it to be brushed into the box of the machine.

A harvest scene of ancient Egypt is shown by an illustration found in a tomb at Thebes, 1490 B. C. The reaper here uses the scythe, which has precedence of every other harvesting machine. The grain seems to have been cut at this time just below the ear.

Other methods of harvesting were practiced in Gaul in the time of Pliny. One was to pull the grain up by the roots, bind it in bunches, and then each bunch was drawn over a comb or hackle. This manner of harvesting is represented in a tomb at Eilethyas.

The Greeks and Romans used the curved sickle of the Egyptians, with but slight alterations. Varro describes three modes of reaping as common in Italy:

1. Cut low by a hook, the ears being afterwards cut off and sent to the granary.
2. Cut off below the head by a toothed sickle, and the heads carried off in baskets.
3. Cut off at half the length of the straw.

From the primitive curved blade of our Anglo-Saxon forefathers many improvements have been made. Modern invention now lays low in the short space of an hour vast fields of ripened grain. No longer is it necessary to bend over the scythe, but a machine propelled by horse-power or steam fells at a swoop the myriads of stalks whose crests are heavy with the seed of wheat, oats, hay, etc.

Later inventions are propelled by steam instead of horse-power. The apparatus consists of a boiler and steam engine, erected on a light wrought-iron girder frame, the whole being carried on four wheels, of which the two hind wheels are utilized for propulsion and the two fore wheels for steerage and for carrying the cutting apparatus free of the ground. This powerful machine is used almost exclusively on the great wheat fields of the West and Northwest.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11.477,239.00	$62,109,668.00
Value of Productions,	17.599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

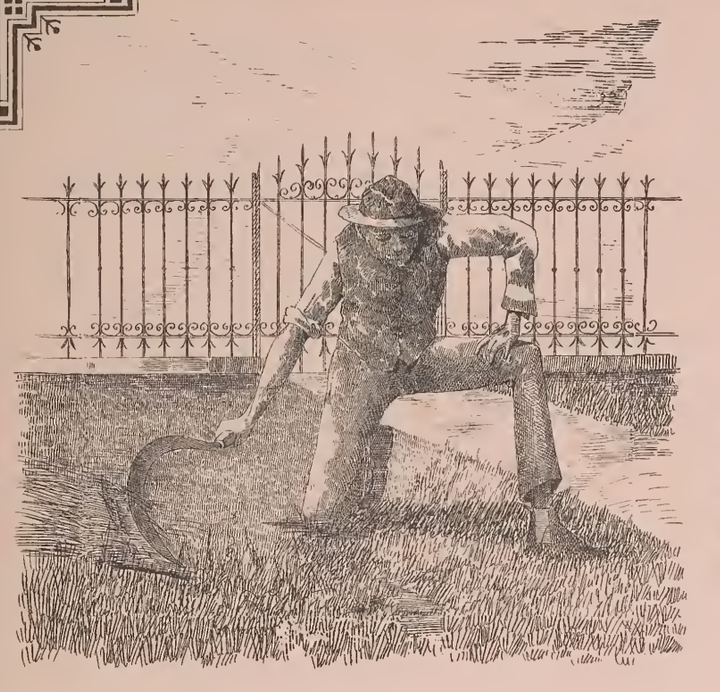
HARVESTER CUTTERS AND MOWERS.

72,090 Manufactured in 1880.

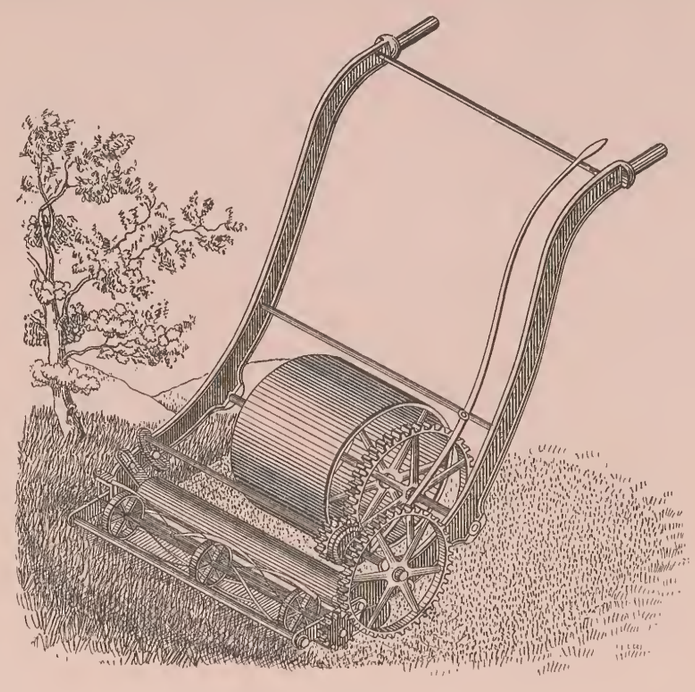
Capacity—	Primitive Mode.	Present Machines
Acres per day,	1½	30
Hands Employed per day,	1	1

1,610 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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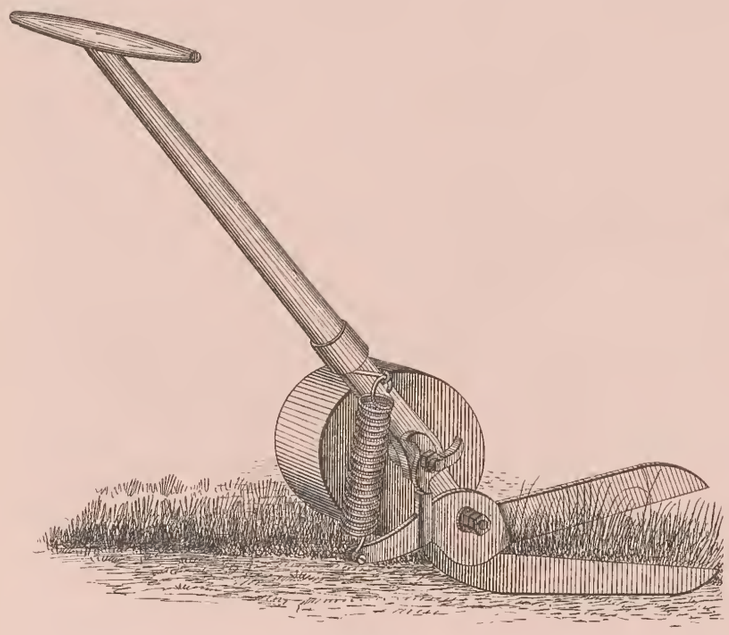
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LAWN MOWERS.

LAWN MOWERS.

No. 1. Hand.
2. English—A. D. 1830.
3. U. S. Patent, Reciprocating Knife—A. D. 1861.
4. " " " " —A. D. 1863.
5. " " Spiral Cutter—A. D. 1868.
6. " " " " —A. D. 1874.
7. " " Edge Trimmer—A. D. 1879.
8. " " " " —A. D. 1883.
9. " " Revolving Cutter—A. D. 1884.

The old English word for lawn is "laund," or "lawnd." The Italian and Spanish is "lande." It is probable that "lawn" and "land" once meant the same.

John Evelyn, a wealthy gentleman of the court of Charles II, devoted much of his leisure and money to pastoral pursuits. He is, perhaps, the first author who wrote of mowing "carpet walks."

Evelyn was one of the founders of what is known as "English landscape gardening." He was born in 1620, and wrote two able books, "Silva" and "Terra", bearing upon the subject. The beautiful lawns around his country house at Sayes Court, near Deptford, were probably mowed with the diminutive primitive scythe, which cost much time and physical exertion.

When Peter the Great was in England he wantonly devastated these grounds. Evelyn complained of it so bitterly that the Government compensated him for the injury done to his property.

Later we read of the beautiful lawns and artificial lake of Kenilworth Castle.

Great attention is paid to the parks and lawns surrounding the country seats in this country and in Europe.

During the warlike times of ruder ages the castles of the nobility were perched upon almost inaccessible hills, on whose rocky heights scarcely a blade of grass could grow. Now, however, a smoothly-shaven lawn is as necessary an adjunct to the houses of the rich and tasteful as the moat and precipitous paths used to be to the castles of the feudal barons.

The tasteful grouping of trees, shrubbery, fountains and statues around our National Capitol, the sloping lawns and well-kept terraces, the ornamental walls that enclose it, are, taken all together, a masterpiece of the art of "landscape gardening."

The great interest taken in reaping and cutting machines, especially between the years 1851 and 1855, in this country, caused the old-fashioned scythe to be superseded by the cylindrical lawn mower.

An apparatus consisting of reciprocating shears was patented in 1800, but was not successful.

The most popular form of the modern lawn mower has a revolving cylinder, armed with spiral knives, which rotate in contact with the rectilinear edge of a stationary knife placed tangentially thereto. The cylinder is rotated by gear connection to the supporting and driving wheels. The machine is made of different sizes to cut a swath of from 18 to 36 inches, and is pushed before him by the gardener.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

LAWN MOWERS.

47,661 Manufactured in 1880.

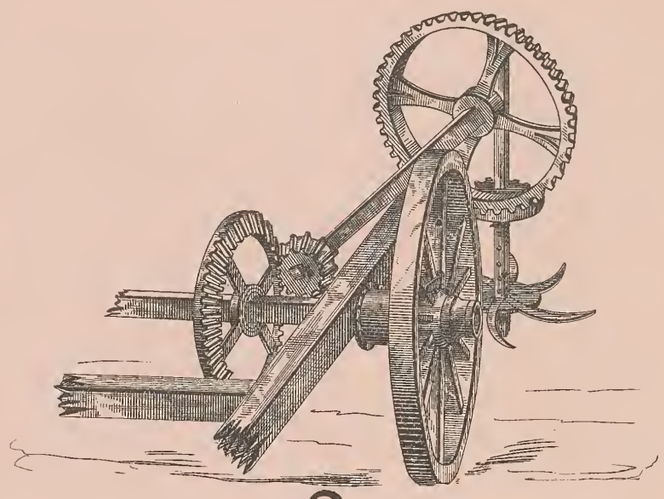
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1	7
Hands Employed per day,	1	1

138 Patents Granted by the United States.

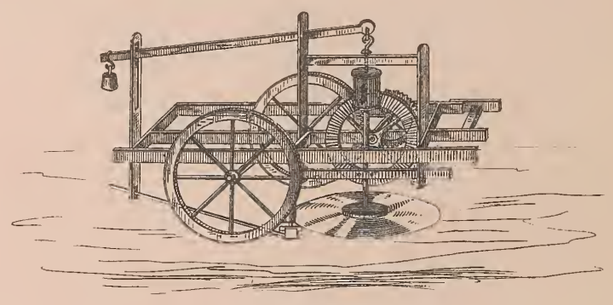
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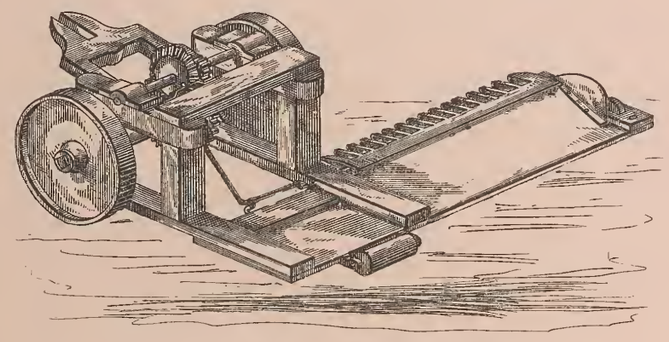
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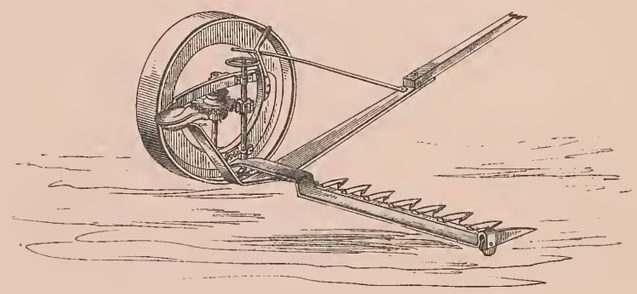
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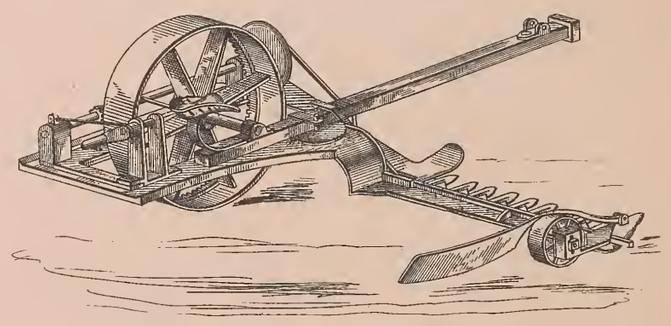
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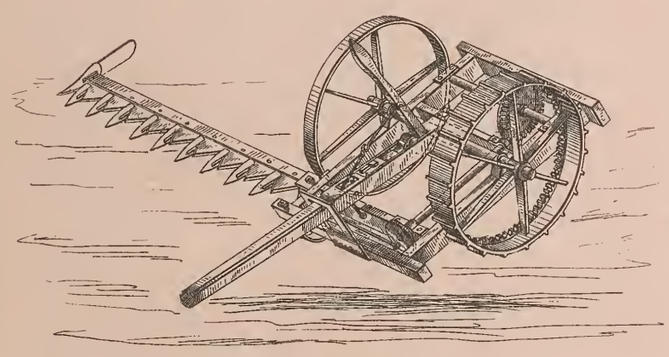
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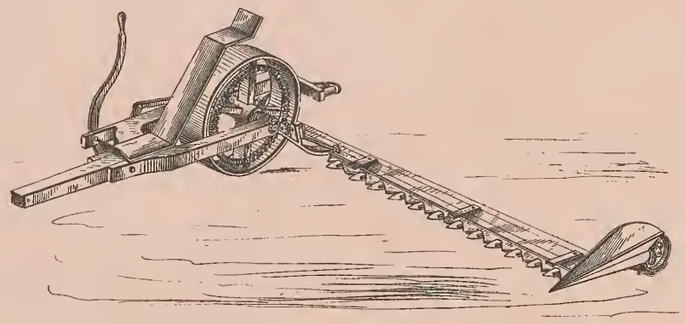
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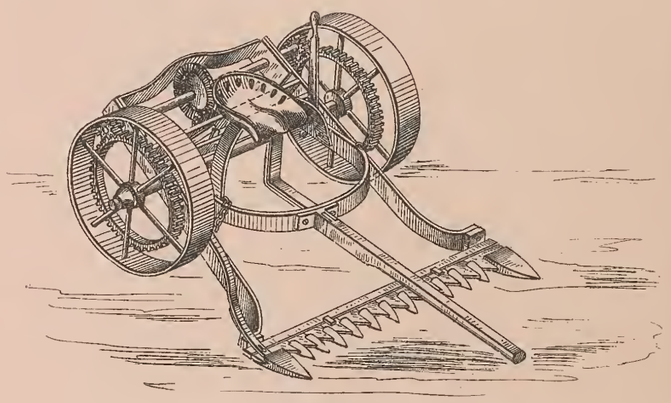
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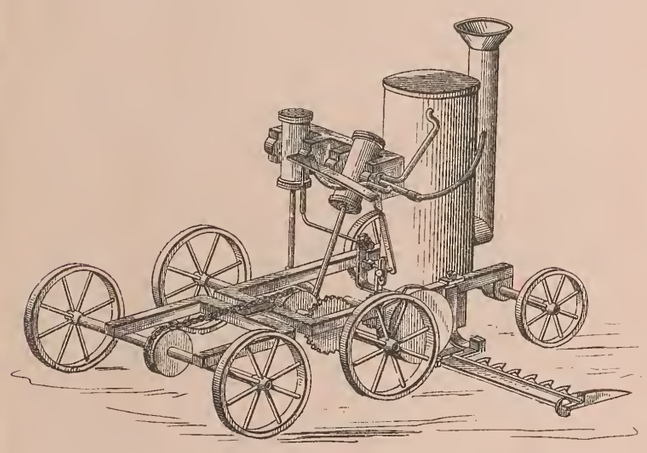
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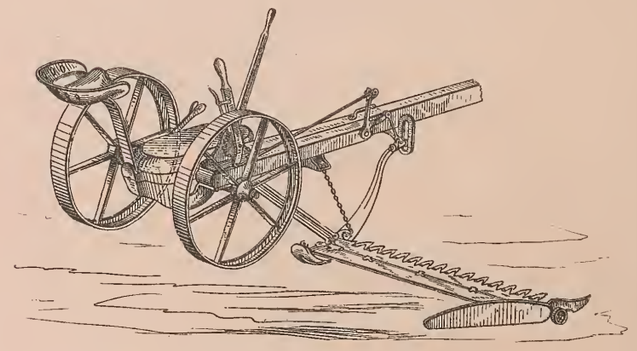
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11



12

MOWERS.

MOWERS.

1. Primitive Hand Scythe.
2. English Mower—A. D. 1799.
3. U. S. Patent, Mower—A. D. 1822.
4. " " Slotted Guard Finger and Mower—A. D. 1833.
5. " " Spokeless Wheel Mower—A. D. 1857.
6. " " Front Cut One-Wheel Mower—A. D. 1857.
7. " " Front Cut Two-Wheeled Mower—A. D. 1858.
8. " " Rear Cut One-Wheeled Mower—A. D. 1858.
9. " " Front Center Cut Mower—A. D. 1863.
10. " " Steam Mower—A. D. 1868.
11. " " Front Cut Two-Wheeled Mower—A. D. 1880.
12. " " " " " " —A. D. 1884.

Mowing was a familiar duty in Palestine, and the Scripture reference to it shows that "the ardent sun" cured the grass in a short time.

Of the scythe, Pliny says, A. D. 79, "there are two varieties, the Italian, one handed, which is shorter and can be handled among brushwood, and the two-handled Gallic.

The first patent granted by the United States for cutting grain and grass bears date May 17, 1803, to Richard French and J. T. Hawkins, of New Jersey.

A mower which had some popularity was invented by Wm. Manning, of New Jersey, in 1831.

Obed Hussey, of Cincinnati, Ohio, in 1833, patented a machine for reaping and cutting all kinds of grain, to which he applied the saw toothed cutters and guards. This machine was publicly exhibited in 1837.

Cyrus McCormick built one hundred and fifty mowers in 1845.

Whilst the names of Smith, Bell, Gladstone, and Scott are well known in connection with the experimental working of this machine in England, the names of Hussey, McCormick, Ketchum, Manny, Adams, and Ten Eyck are equally familiar to the American farmer as the inventors of mowers and reapers.

The mower and reaper had not attracted much attention until the exhibition of American machines at London, in 1852.

The earliest mowing machines made would cut only dry and coarse grass, and work on uplands, and it was thought until a few years ago that it would be impossible to mow grass while the dew was on. A good machine of the present day, however, will mow in all kinds of grass, whether wet or dry, coarse or fine, and some builders warrant their machines to work well in any place where the farmer is willing to ride.

Though the mowing machine was suggested by the ancient Romans, it is believed that the first experiments tending toward practical results were made in Europe in the early part of the present century, while for its general usefulness and present perfection, the world has acknowledged its obligations to the genius and enterprise of American inventors.

The American mower is awarded the palm of superiority the world over.

72,090 mowers were produced in the United States in 1880.

It is said that there are over 300,000 mowers in use at the present time.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories, in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

MOWERS.

72,090 Manufactured in 1880.

Capacity—	Primitive Mode.	Present Machine.
Acres per day,	1½	30
Hands Employed per day,	1	1

1,170 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



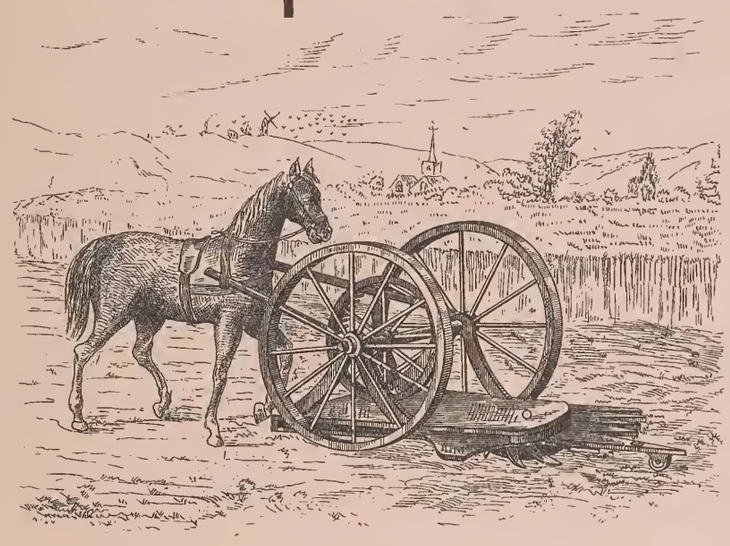
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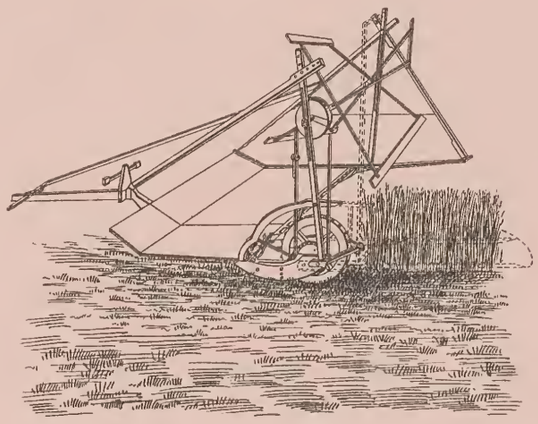
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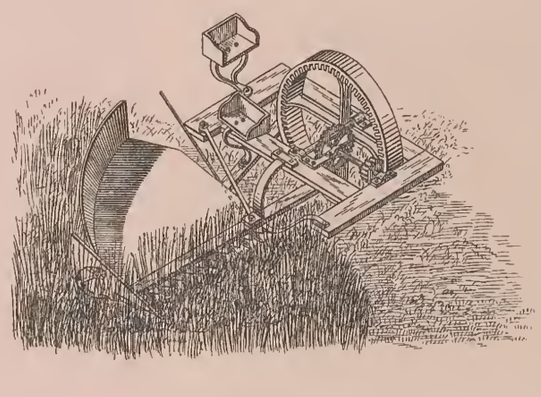
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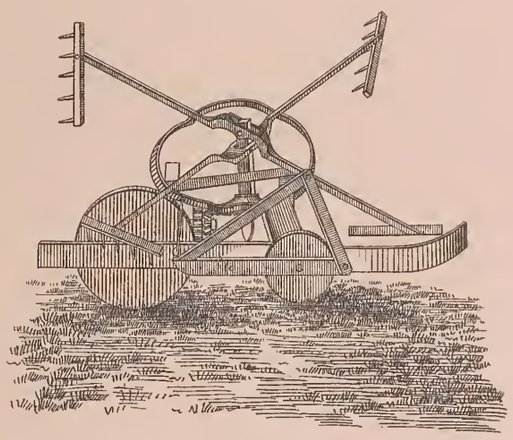
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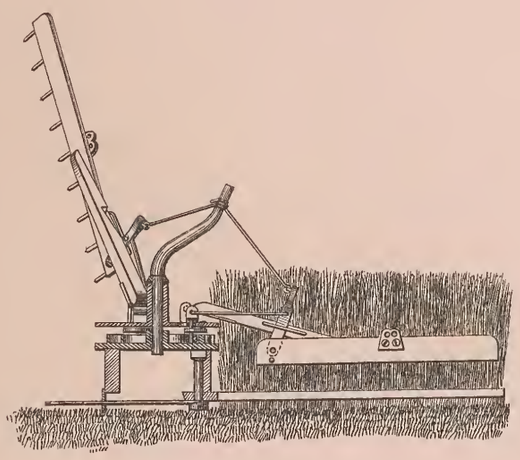
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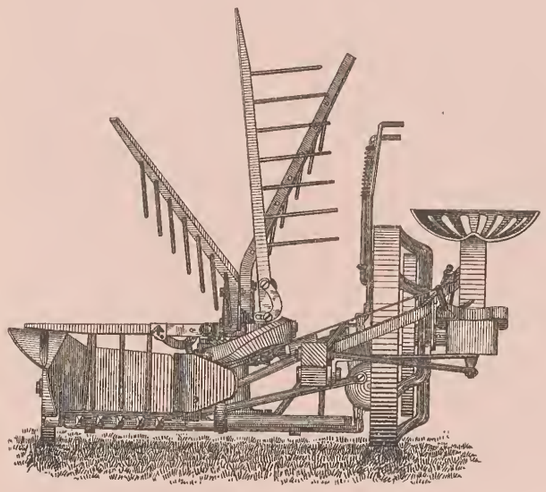
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11



12

REAPERS.

REAPERS.

No. 1. Egyptian Sickle.
2. Colonial "
3. Grain Cradle.
4. English—A. D. 1799.
5. U. S. Patent, Harvester—A. D. 1834.
6. " " Harvester, Hand Raker—A. D. 1855.
7. " " " Self Raker—A. D. 1856.
8. " " " Dropper—A. D. 1861.
9. " " Adjustable Switch Reel Rake—A. D. 1865.
10. " " " " —A. D. 1875.
11. " " " " —A. D. 1879.
12. " " " " —A. D. 1884.

Frequent reference is made in the Bible to reaping, and the sickle wherewith the grain was cut.

The Greeks added nothing, and the Romans very little, to the crude mode of cutting grain by the curved sickle of Egypt.

Gleaning was the common privilege of the poor Egyptians and Israelites, and it is ordained by the law of Moses that "When ye reap of the harvest of your land thou shalt not make clean riddance of the corners of the field; neither shalt thou gather any gleanings of the harvest; thou shalt leave them to the poor and to the stranger."

The Gauls used the reaper A. D. 70. Pliny says that "in the extensive fields in the lowlands of Gaul, vans (carts) of large size, with projecting teeth on the edge, are driven on two wheels through the standing grain by an ox, yoked in a reverse position; in this manner the ears are torn off and fall into the van."

Palladius also wrote a description of this machine in the 4th century.

After a lapse of centuries this form of machine is used for gathering clover.

The first modern machine was similar to the Gallic.

The English machine of Pitt, 1786, had a cylinder, on which were rows of combs which tore off the ears and discharged them in a box of the machine.

In 1799 Boyce, of England, invented the vertical shaft with rotary scythe.

Mr. Gladstone, in 1806, was the first to use the horse in front, beside the uncut grain.

The invention of Henry Ogle, in 1822, marks the commencement of a new era in reaping machines, his machine was of extreme simplicity and used a reciprocating cutter.

The Bell machine, of 1826, which was brought forward to confound the American exhibitors at the World's Fair, held at London, 1857, was pushed ahead of the horses.

In this machine there was the adjustable reel—a method of raising the cutters, and also a mode of delivering the cut grass in line on the ground, to allow any number of binders to work after it.

In the summer of 1855 a competitive trial of reapers took place in France; the competitors were America and England. The American machine cut an acre in 22 minutes; the English machine cut an acre in 66 minutes.

There were produced in the United States in the year 1880 35,327 reaping machines.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

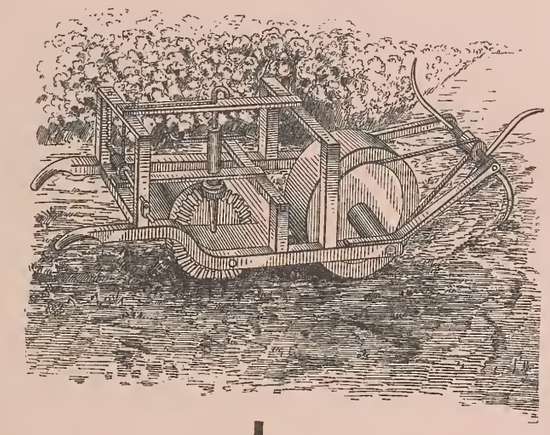
REAPERS.

35,327 Manufactured in 1880.

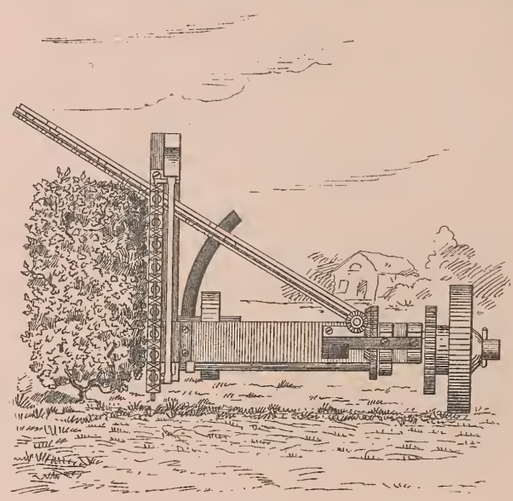
Capacity—	Primitive Mode.	Present Machine
Acres per day,	1½	20
Hands Employed per day,	1	1

1,398 Patents Granted by the United States.

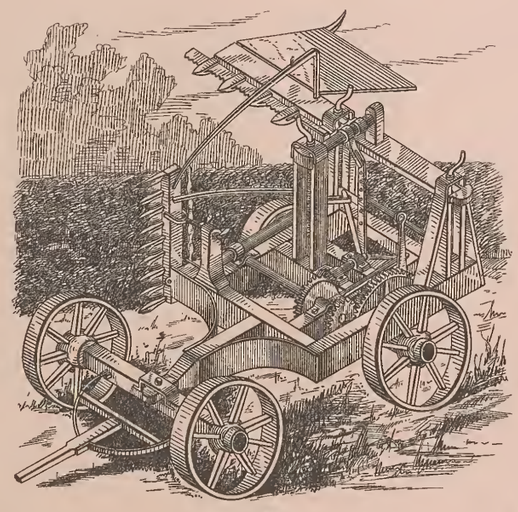
Sackett & Wilhelms Litho Co New York



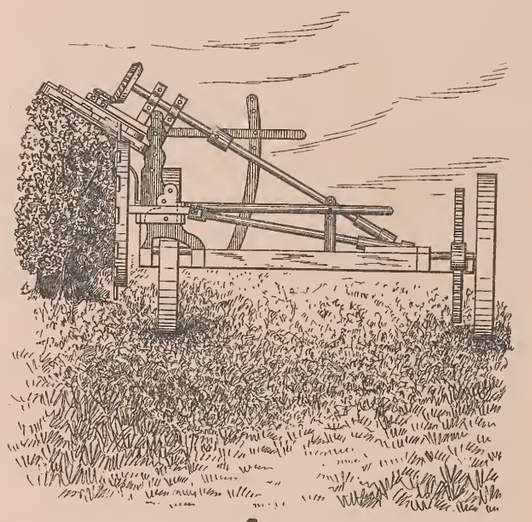
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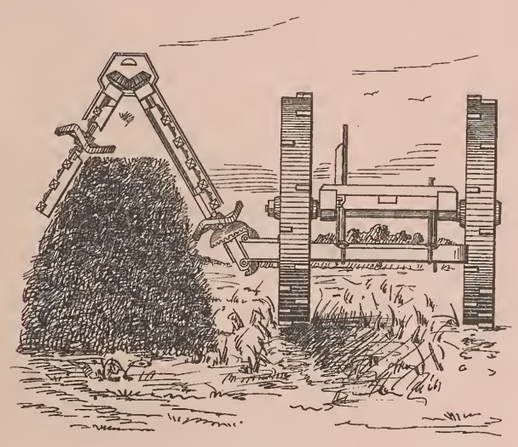
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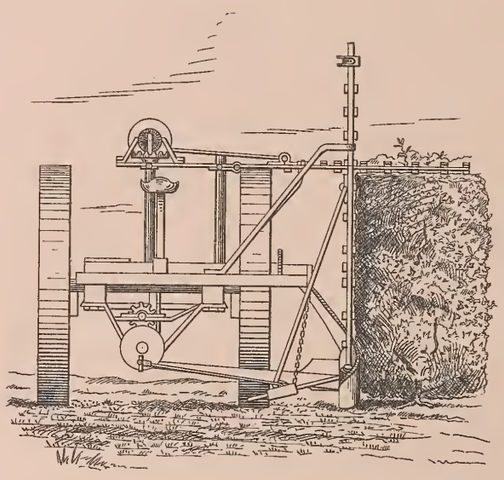
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6

HEDGE TRIMMERS.

HEDGE TRIMMERS.

No 1. U. S. Patent, Horizontal and Vertical Cutter—A. D. 1853.
2. " " Adjustable Side and Top—A. D. 1857.
3. " " " " —A. D. 1857.
4. " " Side and Top Rotary Cutter—A. D. 1866.
5. " " Trimmer—A. D. 1874.
6. " " Top and Side Cutter—A. D. 1882.

The art of clipping trees, says Pliny, "was invented by Martius, a friend of the late Emperor Augustus, within the last eighty years A. D. 79."

The osage orange has a great tendency to run up. It must be clipped savagely to make it spread below. Allowing it an extra three inches of height at each of the three clippings during its first year's growth, in succeeding years it may be allowed to advance about a foot a year, and at the end of five years it should be five feet broad at bottom and five feet high, slanted on each side to a central ridge.

A first class hedge fence is said to be horse high, pig tight, and bull strong.

Hedge clipping machines are made which pass alongside the hedge, and by their revolving cutters trim it to the shape to which the cutting apparatus is adjusted.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested, - -	$11,477,239.00	$62,109,668.00
Value of Productions, - -	17,599,960.00	68,640,486.00
Wages Paid, - - - -	5,080.549.00	15,359,610.00
Hands Employed, - - - -	14,814	39,480

SUB CLASS.

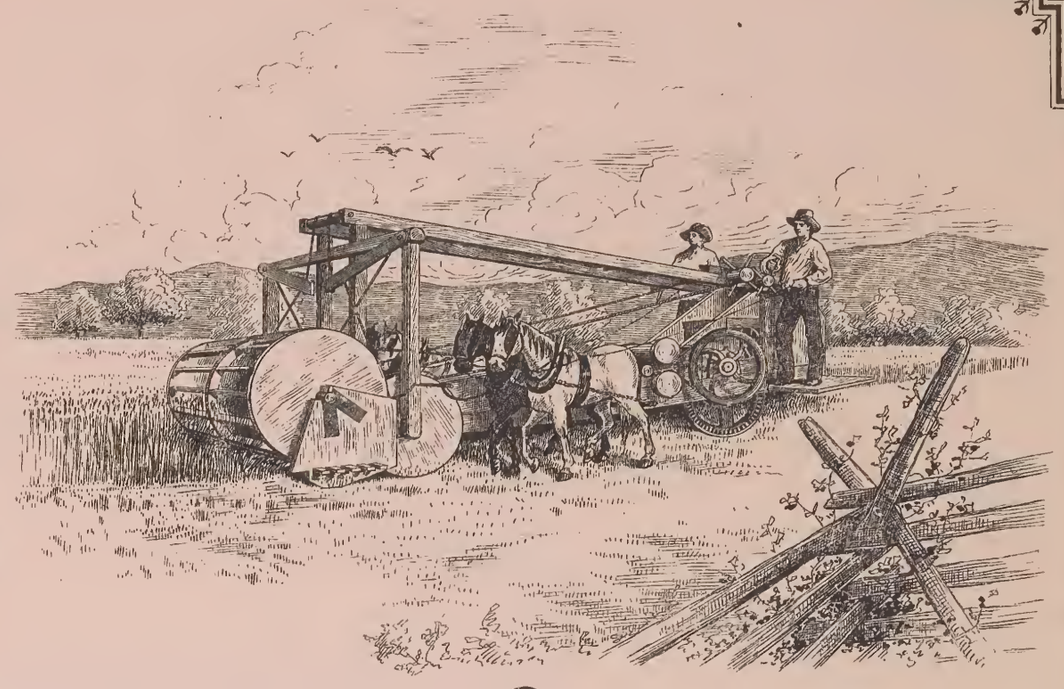
HEDGE TRIMMERS.

50 Patents Granted by the United States.

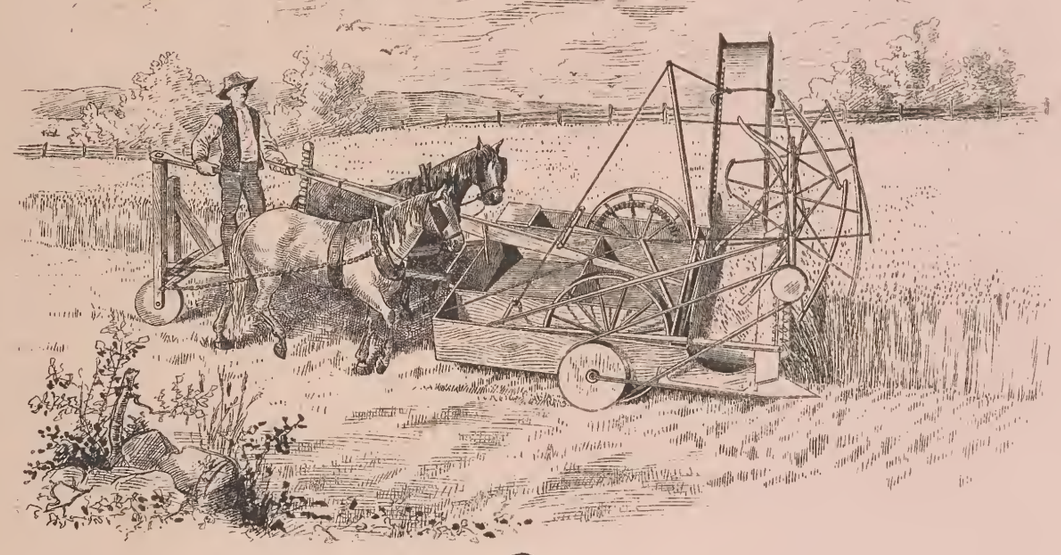
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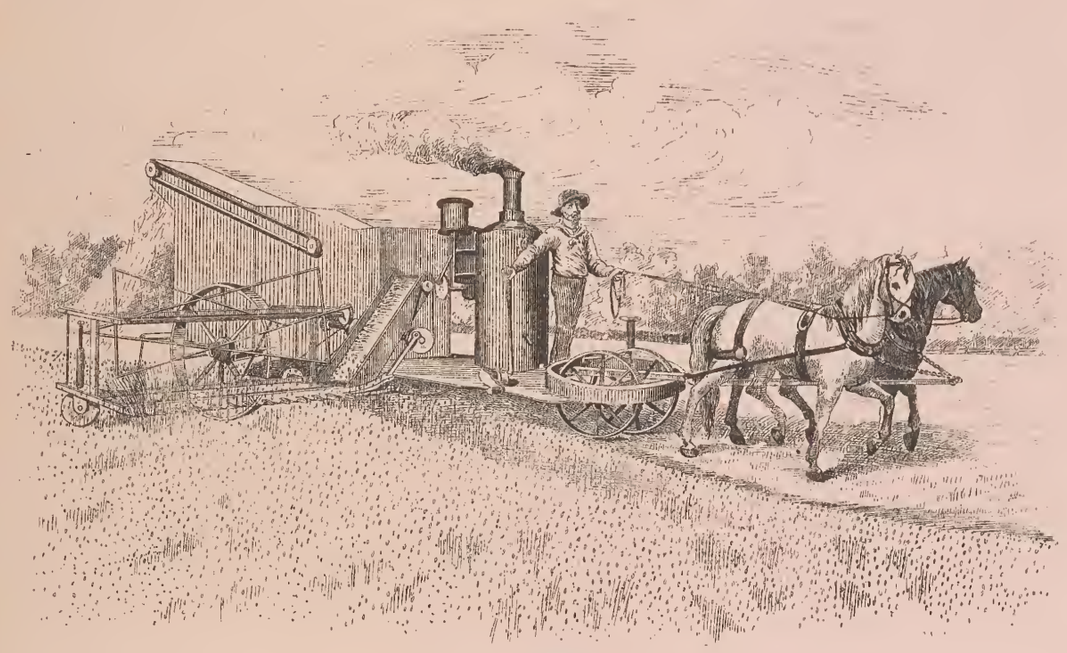
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6

COMBINED REAPERS AND THRASHERS.

COMBINED REAPERS AND THRASHERS.

No. 1. U. S. Patent, Reaper and Thrasher—A. D. 1836.
2. " " Thrasher, Separator and Sacker—A. D. 1846
3. " " Head Cutter and Side Deliverer—A. D. 1849.
4. " " Harvester and Thrasher—A. D. 1877.
5. " " Steam Harvester—A. D. 1879.
6. " " Header, Thrasher and Separator—A. D. 1883.

Under another head is given a full history of harvester cutting apparatus, carrying the reader back to the most ancient devices for cutting grain. An appliance which at once reaps and thrashes is of comparatively modern invention.

In 1828 Samuel Lane, of Maine, invented a reaper with which a thrasher was combined. This combination arrangement has not, however, yet come into general use.

In the State of California the combined reaper and thrasher is found to be more available, as the special conditions of the topography, soil and climate make its use practicable.

The steam harvester is used in all the grain fields of the great West. This cuts the grain in broad swaths, and with incredible rapidity; it is thrashed by the same power.

A portable engine, by whose power the reaper is first propelled and afterwards the thrasher, has been found to be the most convenient method of harvesting the larger crops of grain. The reaper of Cyrus W. McCormick, after which the most notable modern machines may be said to have been modeled, combined, perhaps, more desirable qualities than any others. In this machine, although the reaping and thrashing are not done simultaneously, the grain is so compactly bound as it is reaped that the thrashing can be speedily and conveniently accomplished.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

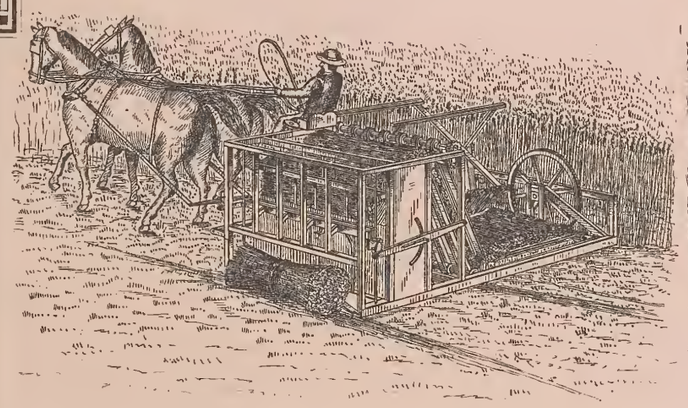
	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

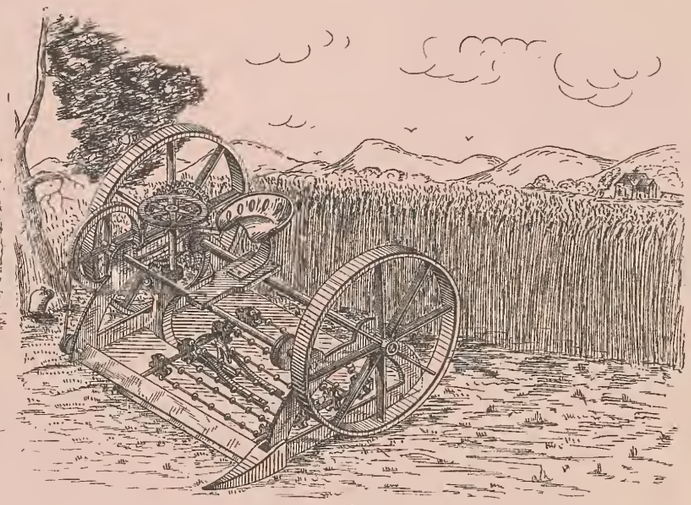
COMBINED REAPERS AND THRASHERS.

44 Patents Granted by the United States.

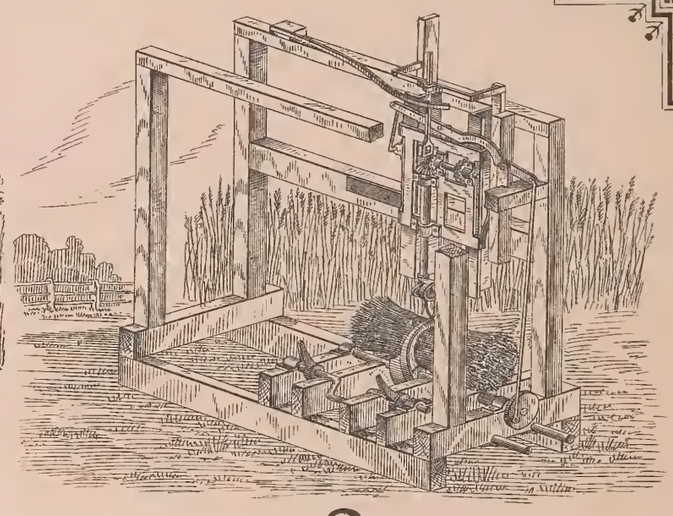
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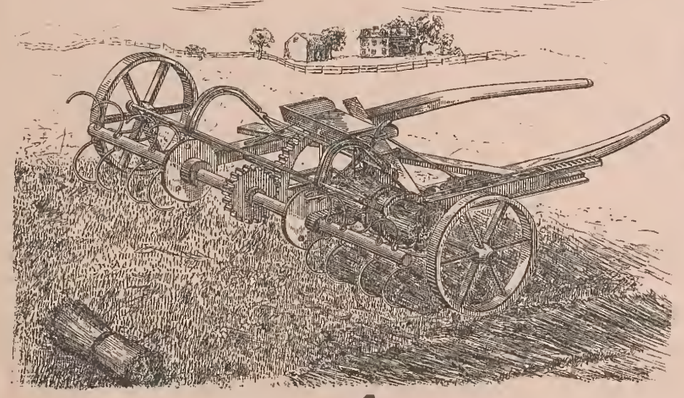
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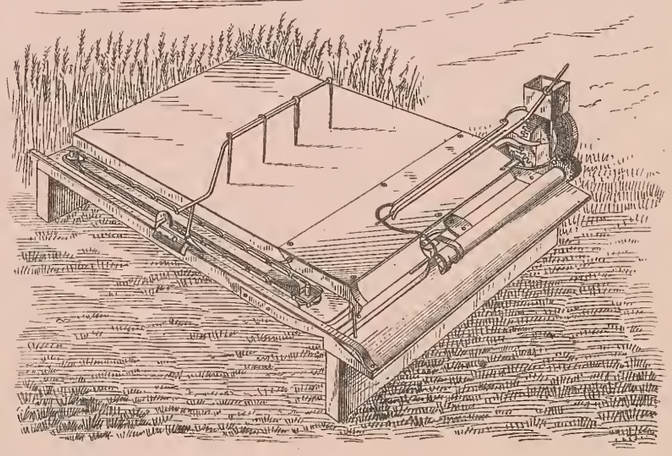
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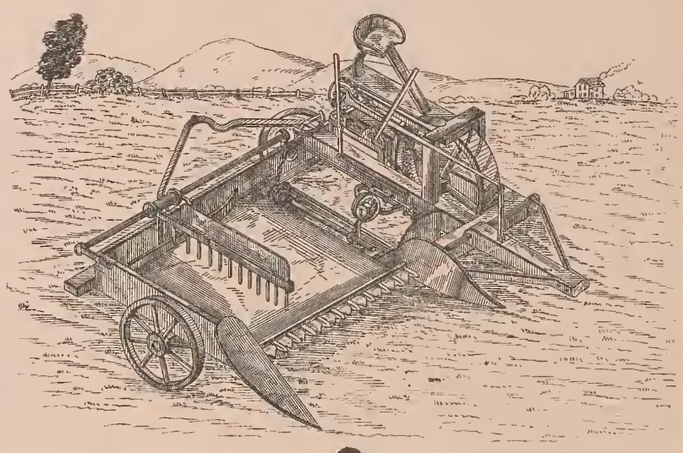
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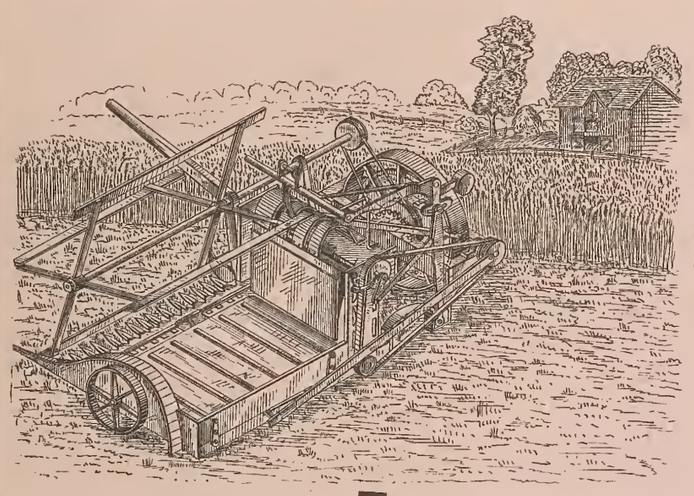
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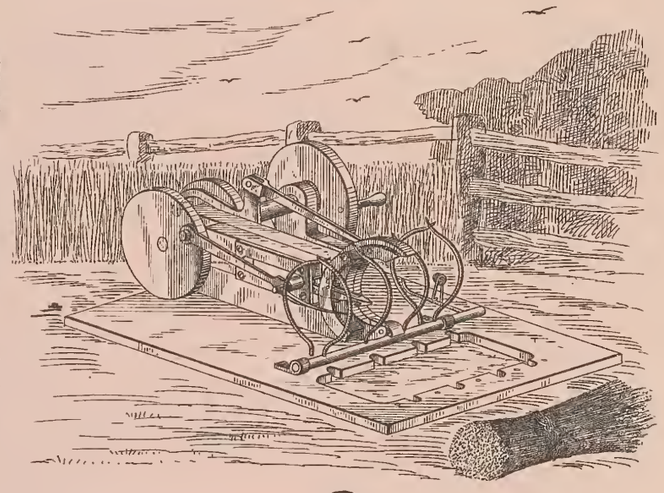
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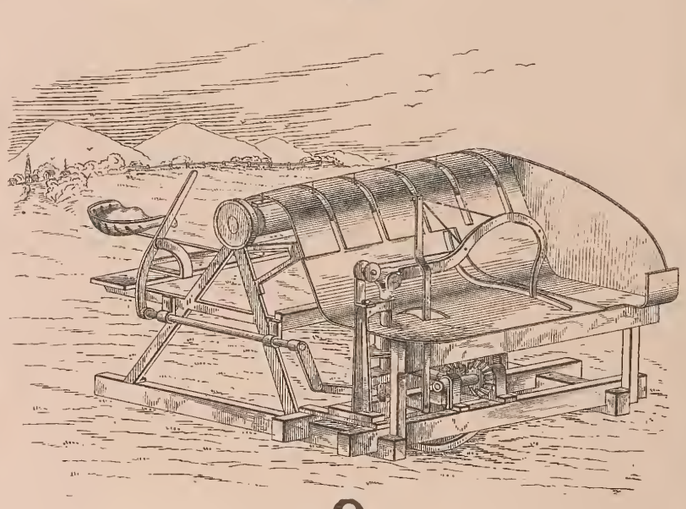
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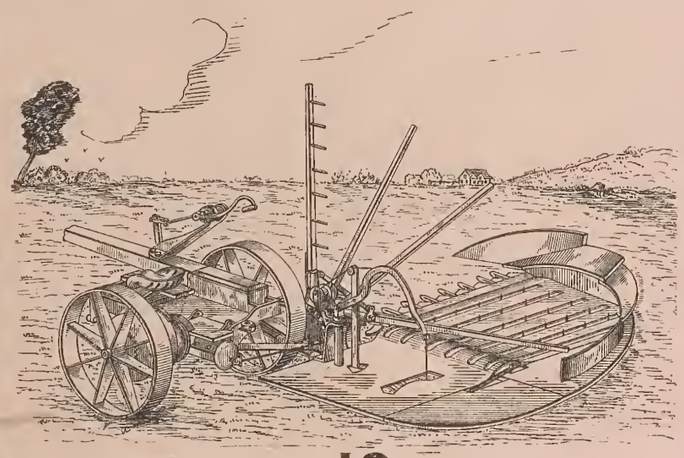
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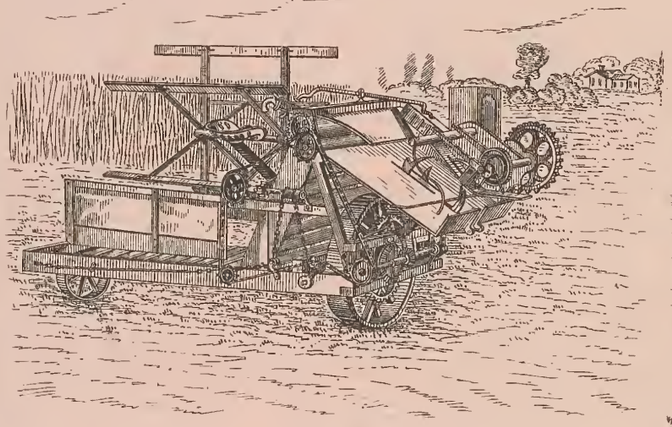
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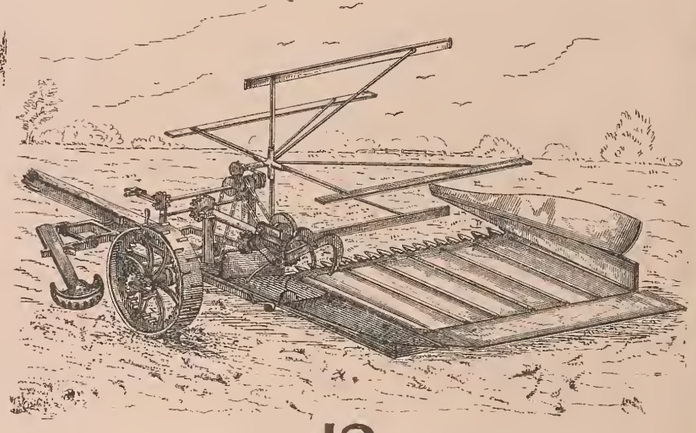
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12

HARVESTER BINDERS.

HARVESTER BINDERS.

No. 1. U. S. Patent, Cord Knotter—A. D. 1853.
2. " " Wire Twister—A. D. 1856.
3. " " Straw Braid Twister—A. D. 1857.
4. " " Gleaner and Binder—A. D. 1862.
5. " " Self Tripping Cord Knotter—A. D. 1867.
6. " " Wire Twister—A. D. 1868.
7. " " Automatic Trip—A. D. 1870.
8. " " Straw Looper—A. D. 1870.
9. " " Vibrating Binder—A. D. 1875.
10. " " Low Down Binder—A. D. 1878.
11. " " Compressor Automatic Trip—A. D. 1879.
12. " " Low Down Oblique Delivery—A. D. 1884

The most primitive method of binding grain was a wisp or bunch of the grain twisted and tied around the bundle. These bundles were stacked together in what are called "sheaves."

A great many experiments have been made to produce a machine which will bind grain as fast as it is cut.

Among the first to succeed at this was Allen Sherwood, of Auburn, N. Y., who was granted a patent for a grain binder in 1858.

A simple sheaf binder is a string strained around a sheaf by means of a notched stick. The band is composed of the two cords knotted together, forming loops.

At the Paris exposition a number of cord and wire binders were exhibited. One exhibitor showed a cord made of twisted bark of osiers; another showed cheap hempen cords in packages of 1,000 each. It was demonstrated that there was a waste in using a bunch of the grain as a binder.

Another patented device is a grain band having a string attached to a block. Both are treated with tar, and are smoked to render them indestructible by humidity, and noxious to insects.

At the Paris exposition in 1878 there were exhibited nine binding reapers—six American and three British. Four American machines went into the field, all of which used the wire binder. Since then each of the owners has placed a twine binder on the market instead. Two twine binders were shown at this exposition, one American and one British, but did not compete on the field. The four competing machines were those of McCormick, Wood, Osborne and Aultman. In the McCormick twine-binding reaper the cut grain is delivered upon a platform, which is a moving web of canvas, which carries it to the elevated aprons and then delivers it upon the binding table. Here a band is placed around the middle of the bundle, tied closely, and the twine or wire cut.

The binding apparatus consists of a needle arm, gripper and discharging device, with the necessary gear. The needle rises through the table when the grain is in place, carrying the twine with it; this encircles the sheaf and a quick knot is tied. The twine string is fed from a tin canister on top of the machine, which can be worked by one man.

The reaping and automatic machine of S. D. Locke, of New York, made by Walter Wood, of that State, is believed to be the most perfect binder, after twelve years of experiment. Since 1874 great numbers of these machines have been put upon the market and are now in successful operation.

Among other successful binders is that of James F. Gordon, of New York, patented in 1874.

Barta's self-binder has also worked successfully. It uses cord and makes a square knot. This is also a recent invention.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

HARVESTER BINDERS.

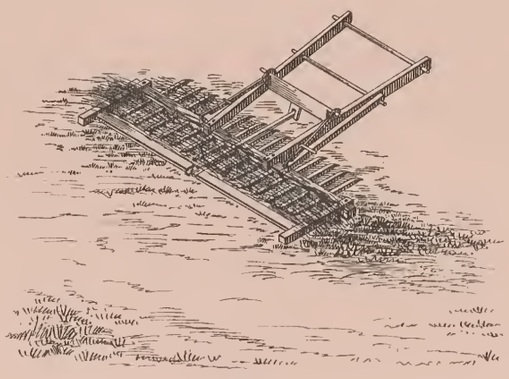
Capacity—	Primitive Mode.	Present Machine.
Acres per day,	½	20
Hands Employed per day,	1	1

697 Patents Granted by the United States.

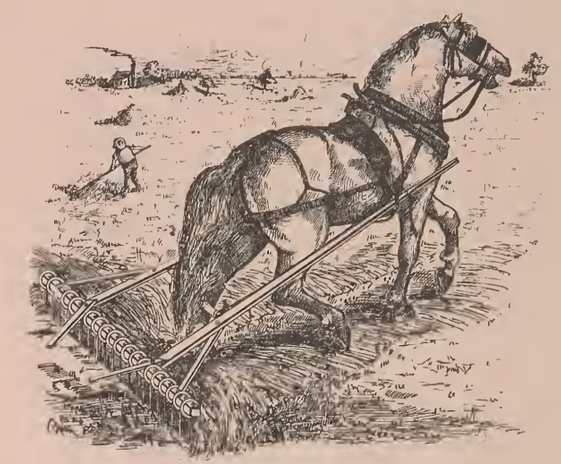
Sackett & Wilhelms Litho Co New York



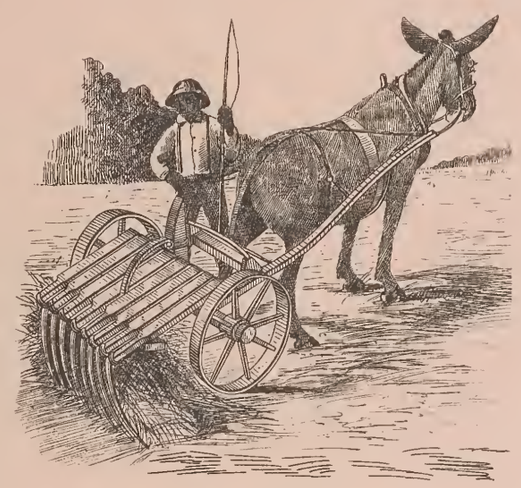
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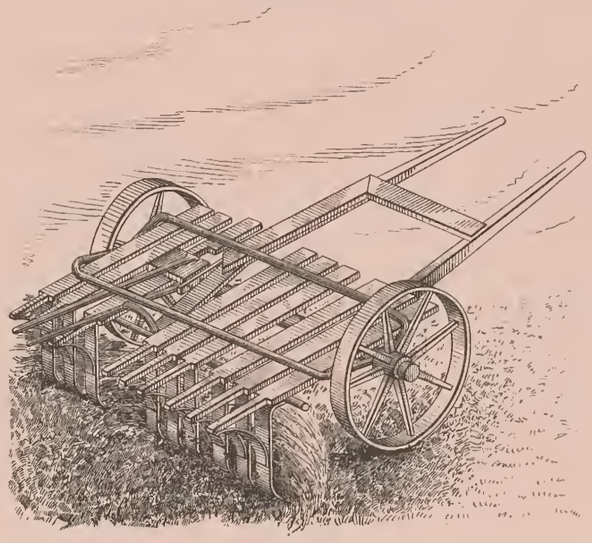
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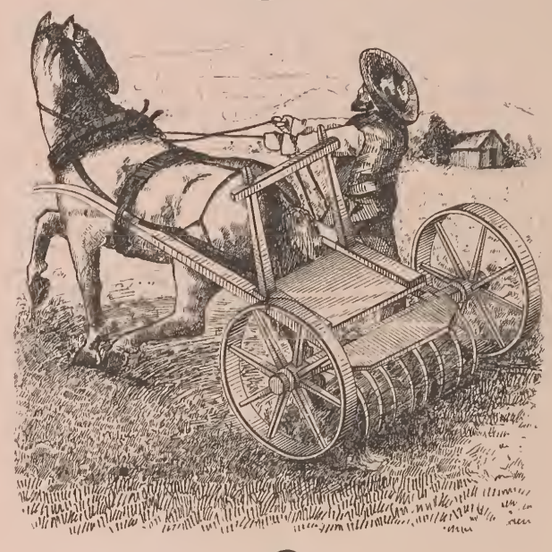
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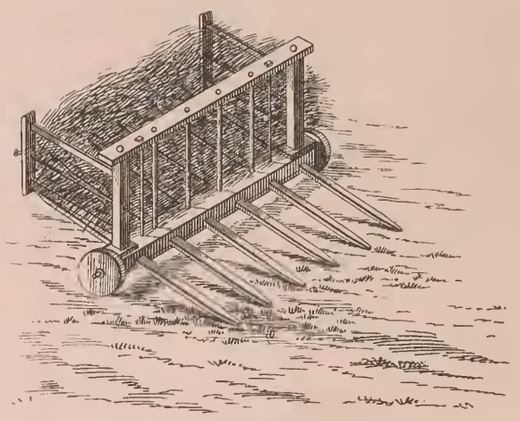
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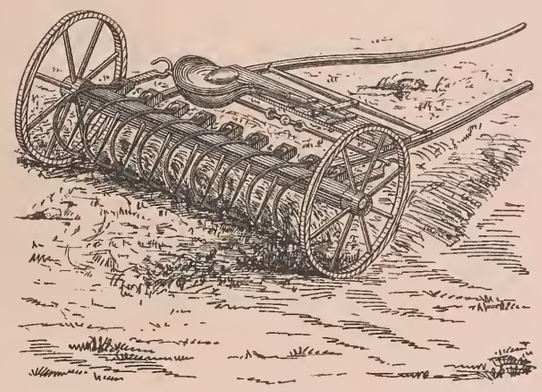
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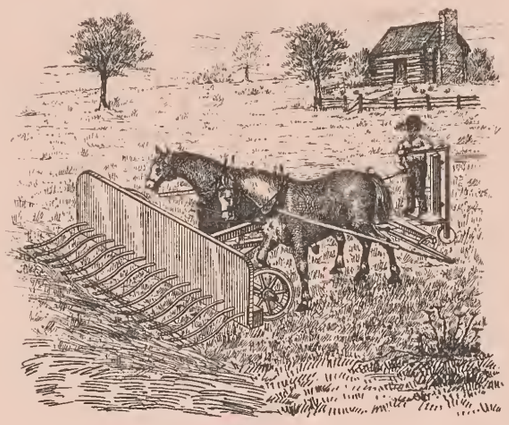
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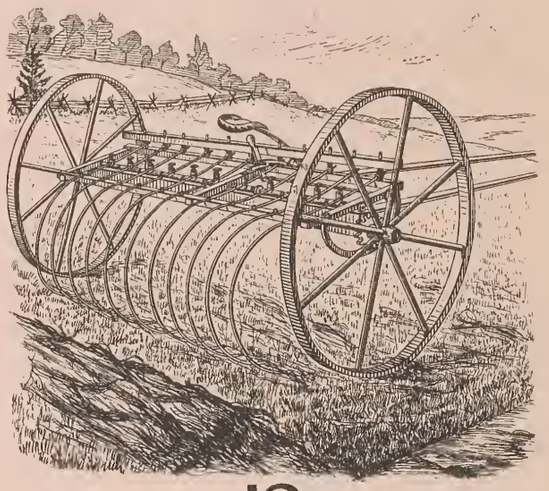
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10



11



12

HORSE RAKES.

HORSE RAKES.

No. 1. Primitive, Hand.
2. U. S. Patent, Flopover—A. D. 1822.
3. " " Spring Tooth—A. D. 1839.
4. " " Dumping Sulky—A. D. 1848.
5. " " Draft Dumping—A. D. 1850.
6. " " Self Dumping—A. D. 1852.
7. " " Spring Tooth Self Dumping—A. D. 1856.
8. " " Draft Dumping—A. D. 1856.
9. " " " " —A. D. 1859.
10. " " Drag " —A. D. 1866.
11. " " Draft " —A. D. 1866.
12. " " Drag " —A. D. 1870.
13. " " Draft " —A. D. 1876.
14. " " " " —A. D. 1884.

The rake is not represented in the sculptures of ancient Egypt.

Grain rakes in Great Britain are made of large size, for raking and gleaning the stubble. The head is four feet long, the teeth of iron four inches long and one and one-half inches apart.

In Scotland a rake is used with a jointed head fifteen feet long; the handle has a cross-bar, and the implement is drawn by two men.

The wheeled hand rake of the United States used for grain or hay was the precursor of the modern horse rake.

The American horse rake with curved steel tires attached to a bar hinged to a light axle tree, was first used in Pennsylvania.

Those having two sets of wooden teeth lying close to the earth and revolving at the will of the driver, were invented by H. N. Tracy, of Vermont.

Horse rakes are of several kinds, and have come into extensive use of late years. They are wheeled or wheelers.

Some rake heads revolve as in the flop-over rake, in others the rake head is formed by, or attached to, the axle or trails behind it, and the teeth are only lifted to deliver the hay.

In some the teeth are independent, so as to yield to obstacles without affecting the operation of the other teeth. The rake head in some cases is turned by hand at the proper moment, but is more commonly arranged to receive motion from the power of the animal when a holding device is released by the driver.

The mower, horse rake, and hay fork are a most effective trio in the business of cutting and saving hay.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

HORSE RAKES.

95,625 Manufactured in 1880.

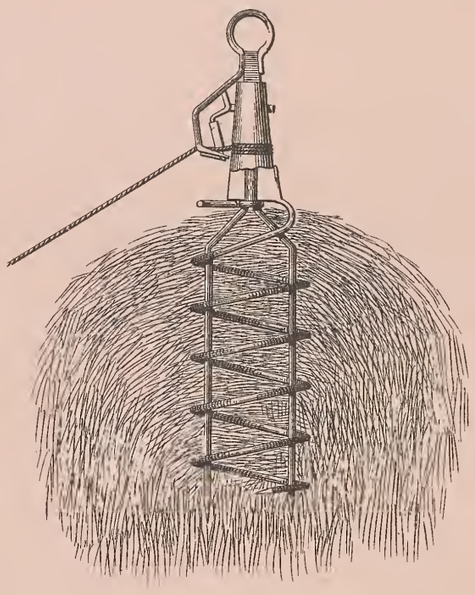
Capacity—	Primitive Made.	Present Machine.
Acres per day,	5	30
Hands employed per day,	1	1

963 Patents Granted by the United States.

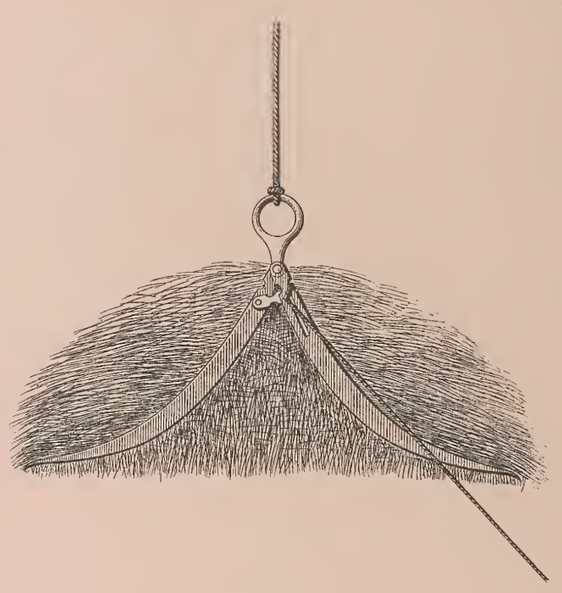
Seckett & Wilhelms Litho Co New York



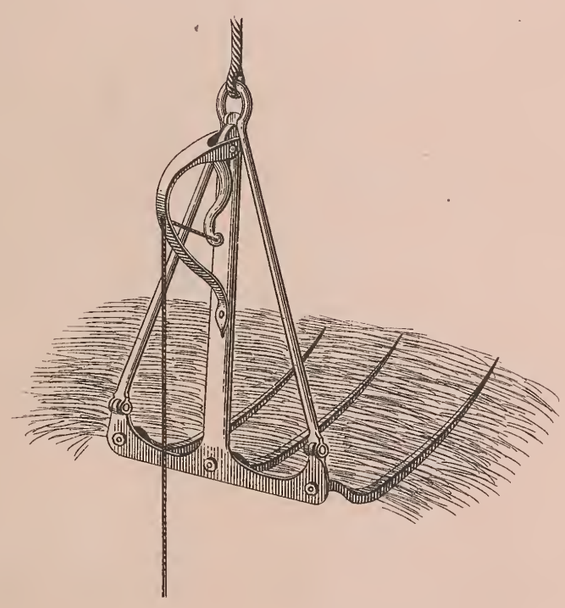
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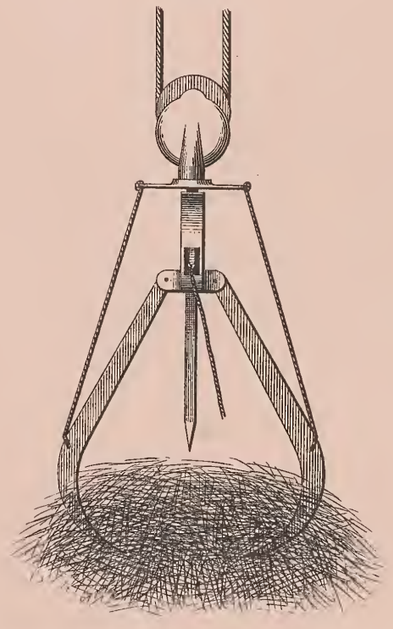
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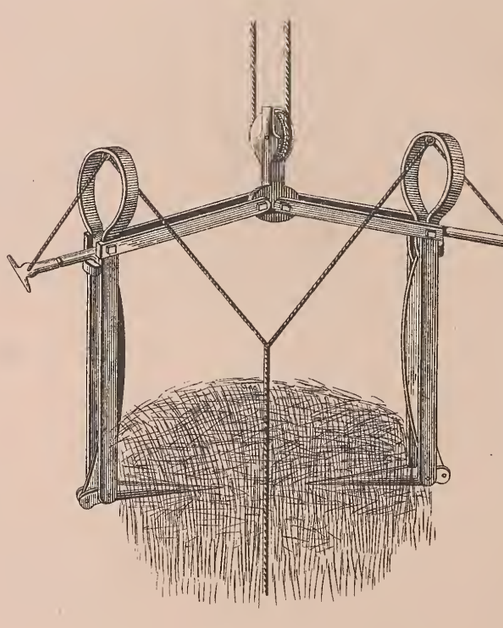
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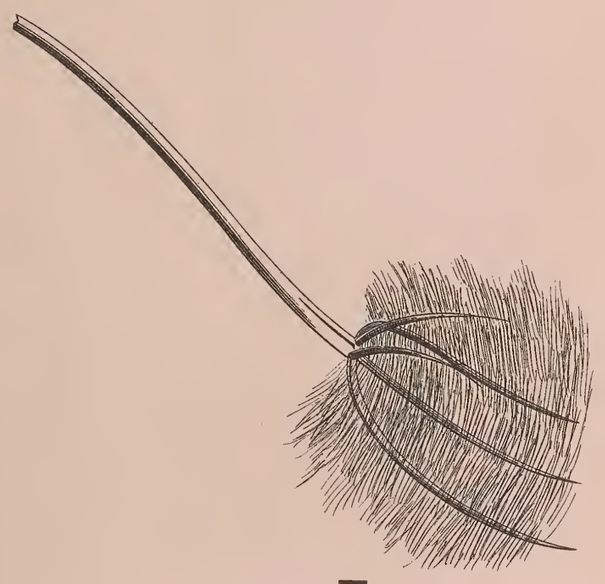
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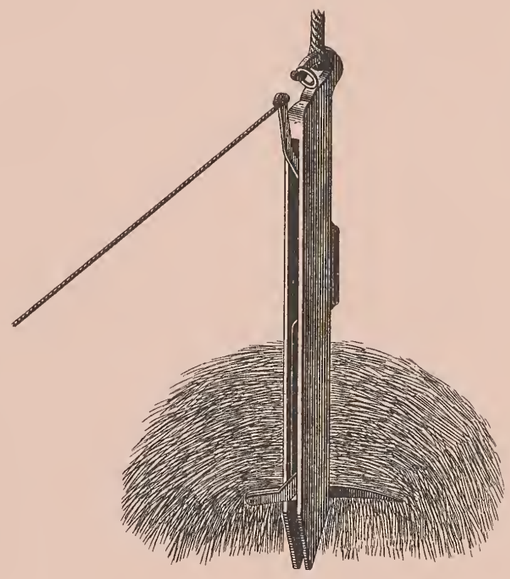
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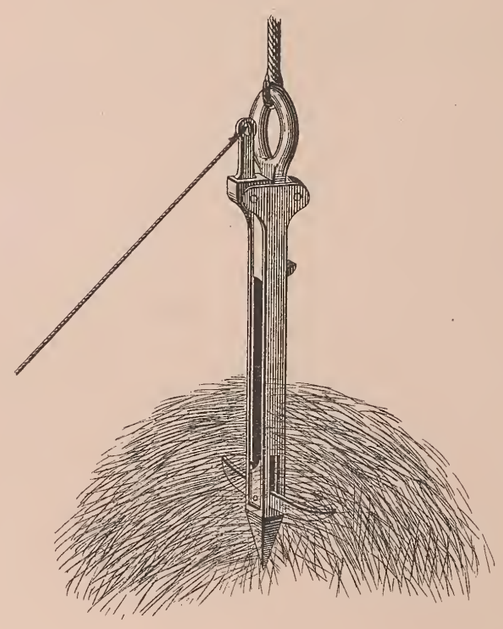
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9

HAY FORKS.

HAY FORKS.

No. 1. Primitive Hand.
2. U. S. Patent, Spiral Horse Fork—A. D. 1867.
3. " " Harpoon Horse Fork—A. D. 1867.
4. " " Tilting Horse Fork—A. D. 1870.
5. " " Grapple Horse Fork—A. D. 1880.
6. " " Harpoon Horse Fork—A. D. 1881.
7. " " Hand Fork—A. D. 1882.
8. " " Harpoon Horse Fork—A. D. 1884.
9. " " " " —A. D. 1884.

The fork of the husbandman is shown on Egyptian tombs, and is referred to in the Book of Judges, 1093 B. C.: "Yet they had a file for the mattocks and for the colters and for the forks."

They are classified in the U. S. Patent Office as hay forks, proper; hay forks, corkscrew; hay forks, grapple; hay forks, harpoon; hay forks, tilting.

HAY FORKS.

476 Patents Granted by the United States.

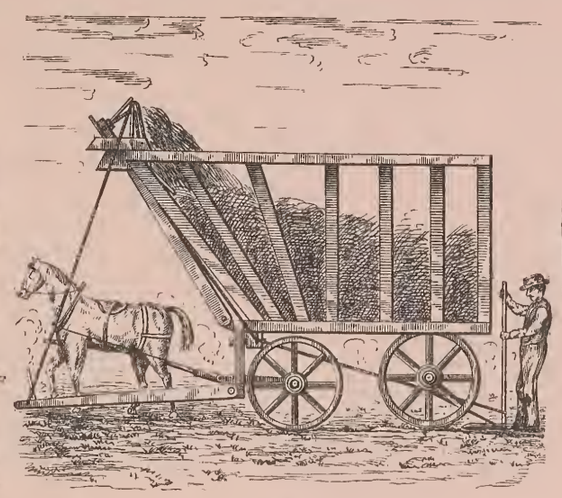
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U.S. PATENT OFFICE

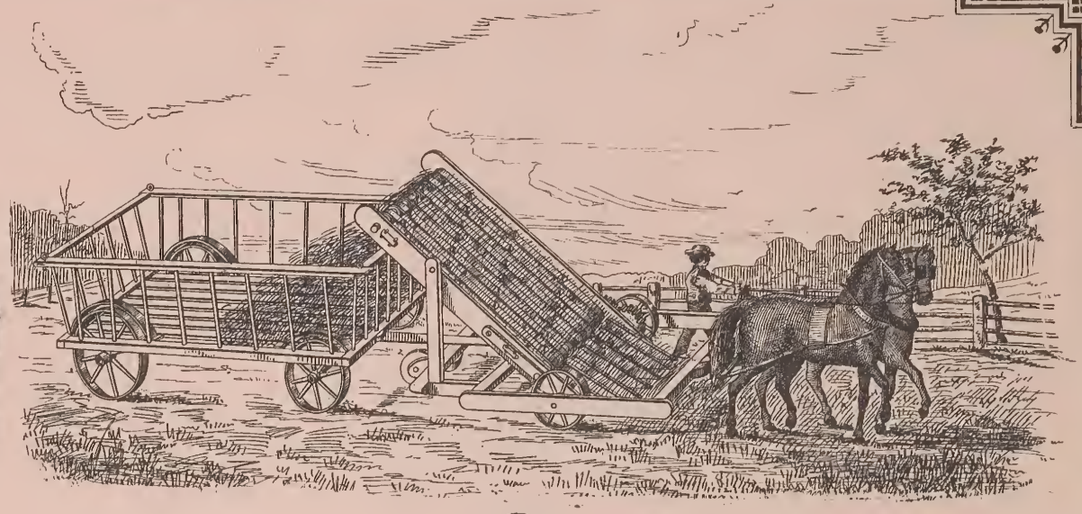
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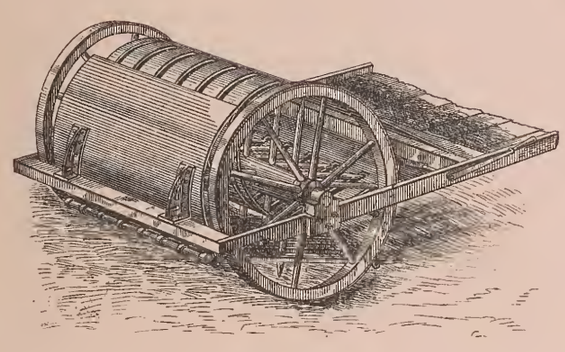
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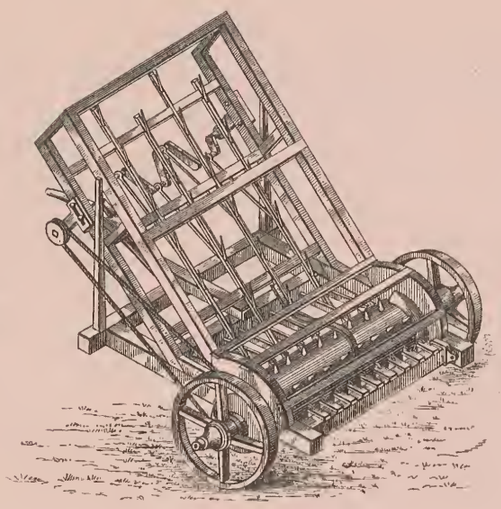
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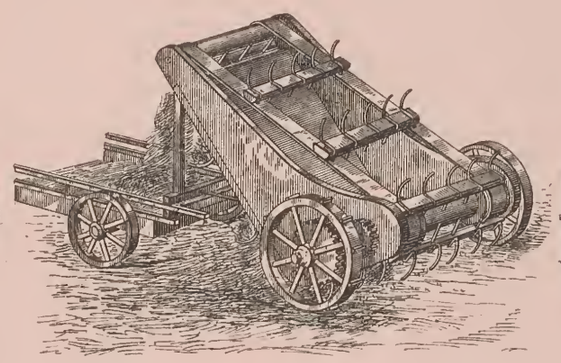
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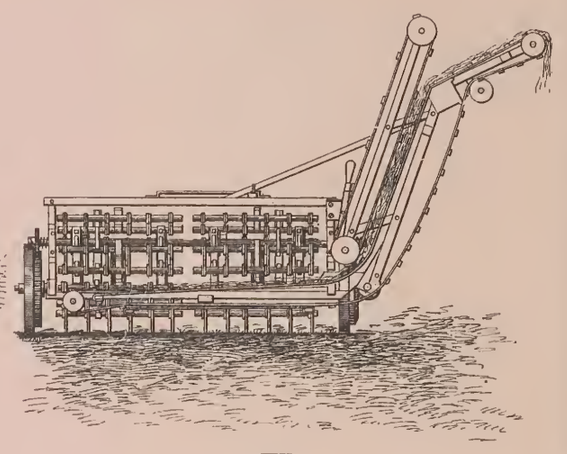
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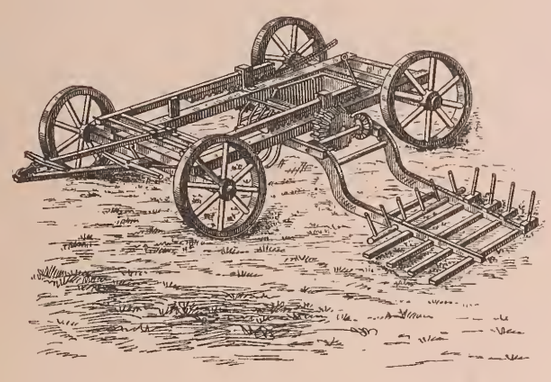
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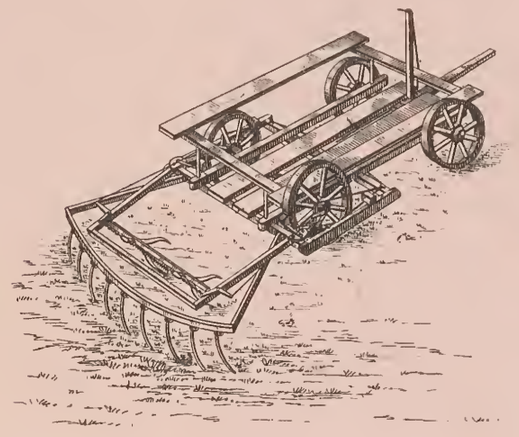
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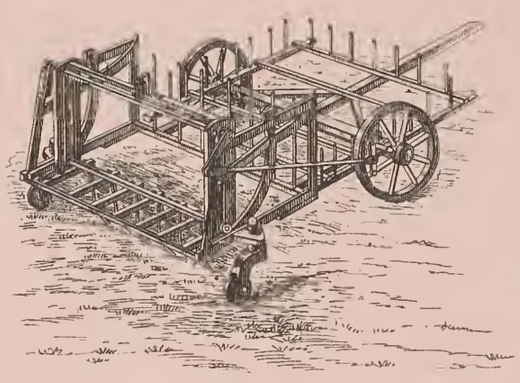
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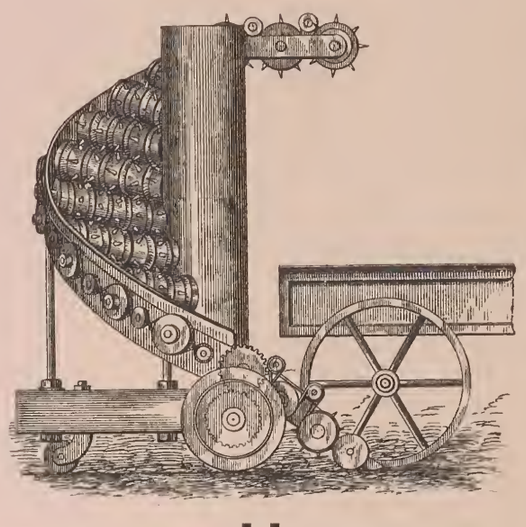
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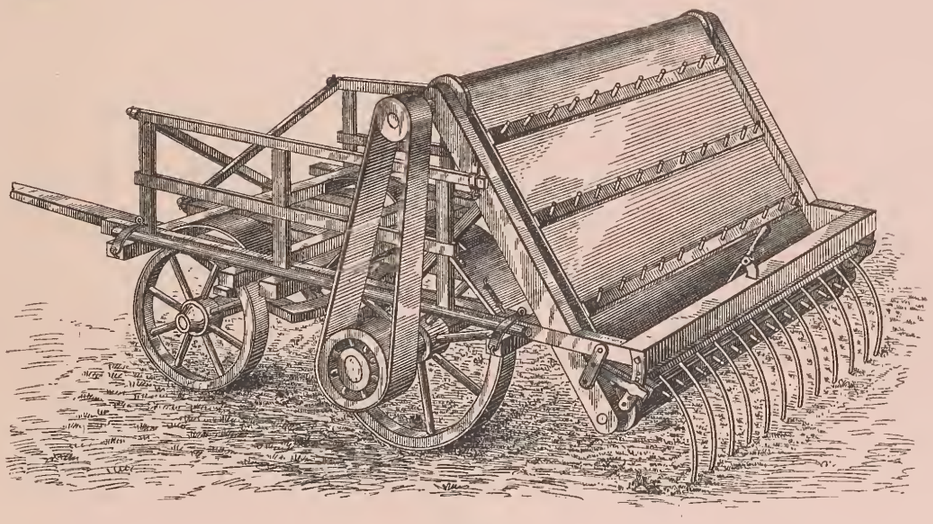
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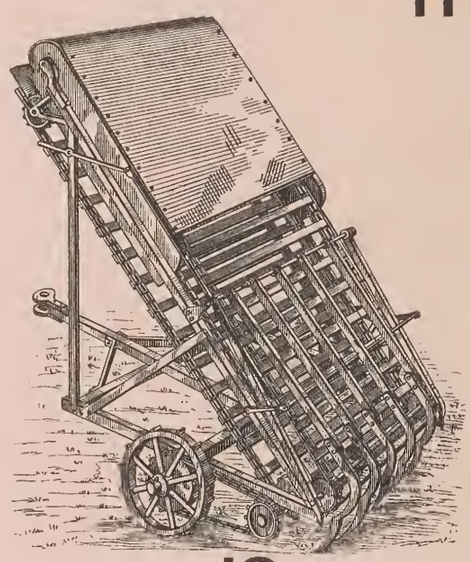
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13

HAY LOADERS.

HAY LOADERS.

No. 1. Primitive, Hand.
2. U. S. Patent, Raker and Loader—A. D. 1848.
3. " " " " —A. D. 1850.
4. " " Reel Raker and Loader—A. D. 1858.
5. " " Walking Reel Loader—A. D. 1860.
6. " " Endless Belt Loader—A. D. 1861.
7. " " Side Delivering Raker and Loader—A. D. 1864.
8. " " Lifting Drag Rake Loader—A. D. 1865.
9. " " Raker and Loader—A. D. 1867.
10. " " Intermittent Action Loader—A. D. 1868.
11. " " Spiral Elevator—A. D. 1870.
12. " " Raker and Loader—A. D. 1876.
13. " " " " —A. D. 1883.

Hay is commonly made of grasses, a few leguminous plants, and clover.

Plants are in the best state to be cut for fodder when in blossom, or just out of blossom.

The cutting of grass for hay is done by hand scythes, or horse power and steam-propelled machines.

The swaths are shaken out and exposed to the sun by machines called tedders or spreaders. When dry the hay is raked together by horse rakes into long heaps called "windrows." These "windrows" are divided and formed into conical heaps and called "cocks."

Horse hay forks were originally used to hoist the hay on the wagons and into barns. These hay forks are arranged so that by a system of ropes, blocks and rods, the hay is lifted from the load upon the forks and delivered in any section of the barn.

The inventive genius of this century has perfected a machine after many trials, by which the "windrows" are speedily gathered up and lifted through a series of spiral attachments to a point above the hay wagon, whence it is deposited in the wagon.

This invention can be worked either by steam or horse power. The work is done with great rapidity and thoroughness. In isolated districts the old-fashioned hay fork is still used, but improvements in the shape and capacity of the fork are apparent.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080.549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

HAY LOADERS.

8,957 Manufactured in 1880.

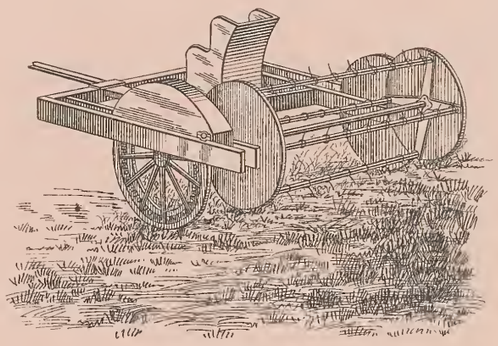
Capacity—	Primitive Mode.	Present Machine.
Tons per day,	4	25
Hands Employed per day,	2	2

266 Patents Granted by the United States.

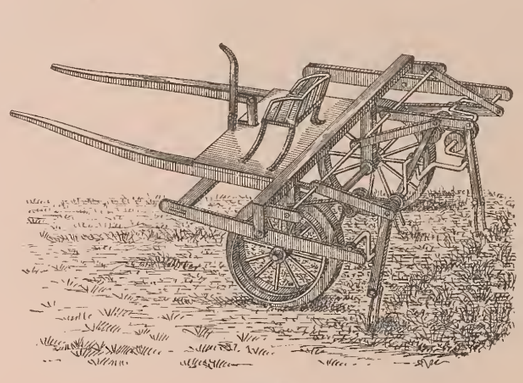
Sackett & Wilhelms Litho Co New York



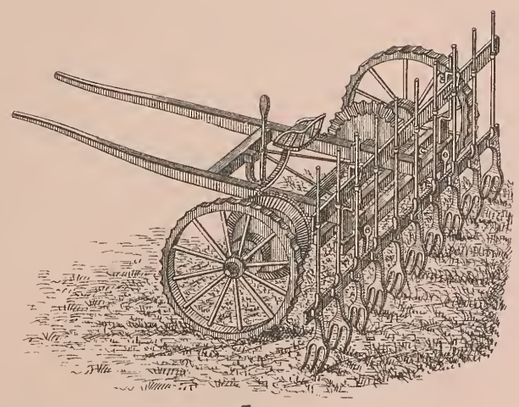
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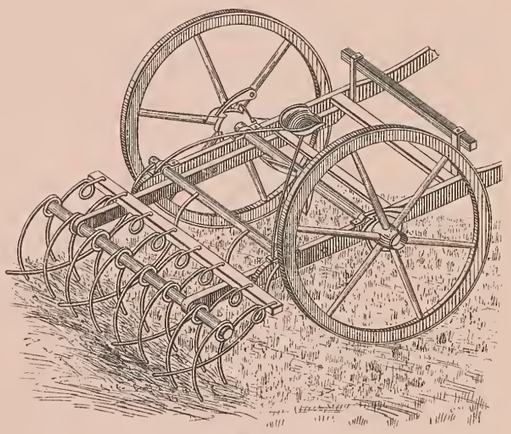
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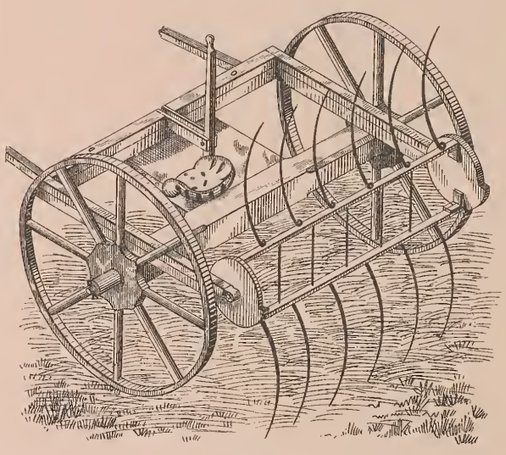
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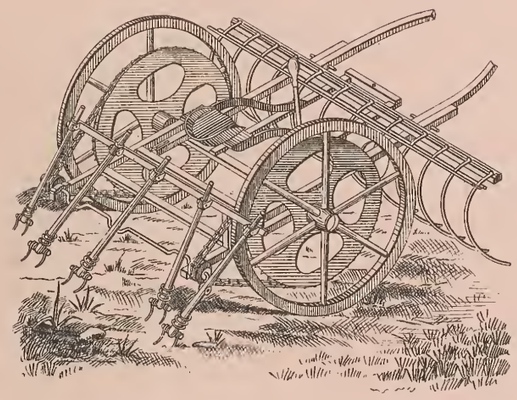
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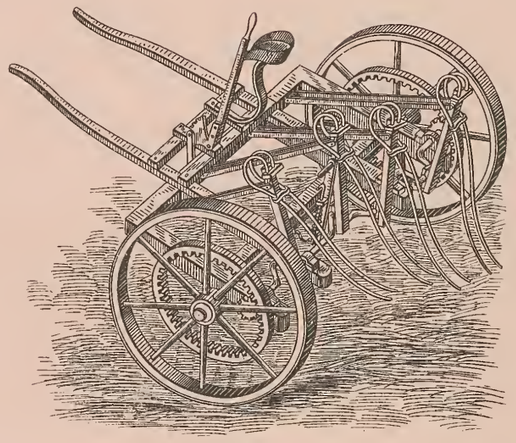
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8

HAY TEDDERS.

HAY TEDDERS.

No. 1. Hand.
2. U. S. Patent, Tedder—A. D. 1855.
3. " " " —A. D. 1861.
4. " " " —A. D. 1862.
5. " " Rake and Tedder—A. D. 1865.
6. " " " " —A. D. 1867.
7. " " " " —A. D. 1870.
8. " " Tedder—A. D. 1883.

The hay tedder was invented about 1800 by Salmon, of England, and is more useful in the humid climate of that country than the United States. It consists of a pair of wheels supporting a reel, consisting of an open cylindrical frame, formed by arms proceeding from it and carrying bars set with curved tines pointing outward. This reel may be lifted out of operative position when going to and from work in the field, and when at work it is rotated by a pinion connection to a spur wheel in the hub of one wheel.

By the use of the modern tedder, which upturns the new-cut and half-cured grass as it lies upon the ground and promotes its more rapid curing, the risk of exposures to summer storms is greatly lessened.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1880
Capital Invested,	$62,109,668.00
Value of Productions,	68,640,486.00
Wages Paid,	15,359,610.00
Hands Employed,	39,480

SUB CLASS.

HAY TEDDERS.

2,334 Manufactured in 1880.

Capacity—	Primitive Mode.	Present Machine.
Acres per day,	5	40
Hands Employed per day,	1	1

122 Patents Granted by the United States.

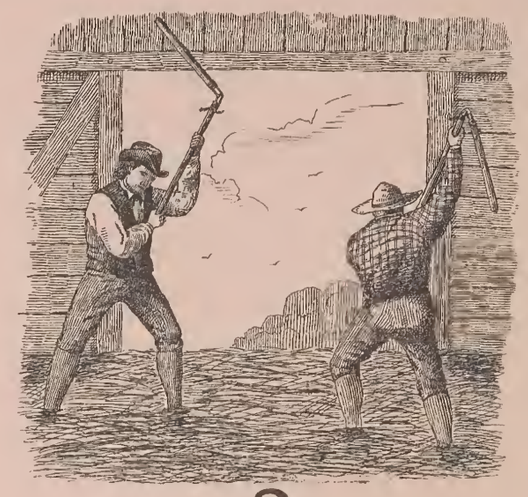
Sackett & Wilhelms Litho Co New York



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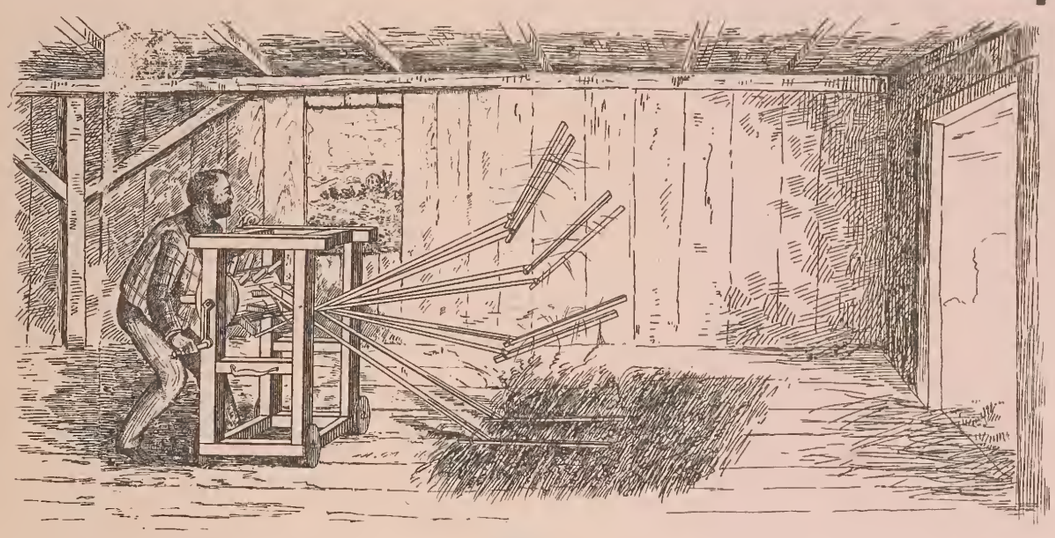
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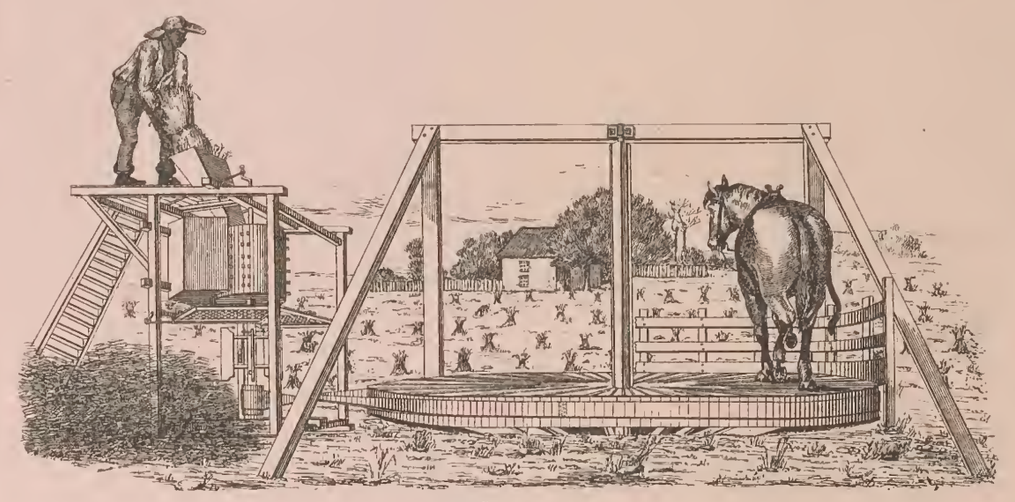
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7

THRASHING AND CLEANING GRAIN.

THRASHING AND CLEANING GRAIN.

No. 1. Egyptian—1500 B. C.
2. Roman Tribulum—100 B. C.
3. Hand Flail.
4. Horse Thrashing.
5. Flail Thrashing Machine.
6. U. S. Patent, Horse Power, A. D. 1834.
7. " " Steam Power, A. D. 1883.

Oxen were anciently employed in thrashing corn, and the same custom is still retained in Egypt and the east. This operation is effected by trampling upon the sheaves, and by dragging a clumsy machine, furnished with three rollers. A wooden chair is attached to the machine, and on this a driver seats himself, urging his oxen backwards and forwards among the sheaves, which have previously been thrown into a heap of about eight feet wide and two in height. The grain thus beaten out is collected in an open place, and shaken against the wind by an attendant with a small shovel, or, as it is termed, a winnowing fan, which disperses the chaff and leaves the grain uninjured.

Horace further tells us that the thrashing floor was mostly a smooth space, surrounded with mud walls, having a barn or garner on one side; occasionally an open field, outside the walls, was selected for this purpose, yet uniformly before the town or city gates. Such was the void place wherein the "King of Israel, and Jehoshaphat, King of Judah sat, each of them on his throne, clothed in his robes, at the entering in of the gate of Samaria, and all the prophets prophesied before them."

In the marginal reading we are informed that this void space was no other than a thrashing floor; and truly the area was well adapted for such an assemblage, being equally suited to accommodate the two kings and their attendants, and to separate them from the populace.

A four-horse power portable engine with six-inch cylinder, pressure of steam 45 pounds per square inch, revolutions, 140 per minute, has thrashed, under favorable surroundings, 320 bushels per day of ten hours; coal consumed 3 cwt. Another engine, of five-horse power, thrashed 400 bushels; coal consumed 4 cwt. Another, of six-horse power, thrashed 480 bushels; coal consumed 5 cwt. Another, of seven-horse power, thrashed 560 bushels; coal consumed 6 cwt. Another, of eight-horse power, thrashed 640 bushels; coal consumed 7 cwt. Another of ten-horse power, thrashed 800 bushels per day; coal consumed 9 cwt.

The economy of these performances is evident at a glance, and even if much less work than the above was effected, such an engine would, if mounted on wheels, prove a most valuable acquisition to any neighborhood composed of thrifty farmers, who might, by an equitable arrangement, become both the owners and beneficiaries of the same.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,589,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610[illegible]6
Hands Employed,	14,814	39,480

SUB CLASS.

THRASHING AND CLEANING GRAIN.

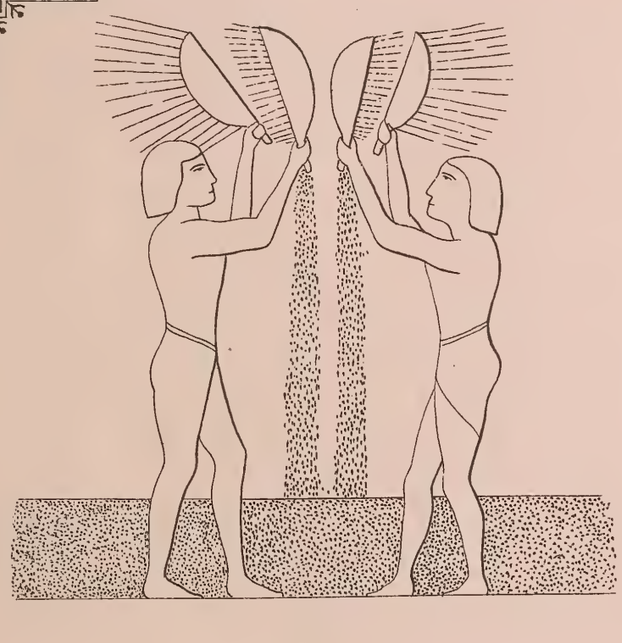
19,527 Machines Manufactured in 1880.

Capacity—	Primitive Mode.	Present Machine.
Bushels Wheat per day,	20	1,000
" Oats "	40	2,000
Hands Employed per day,	4	4

Grain Thrashed, 1883, 1,540,000,000 Bushels.

2,615 Patents Granted by the United States.

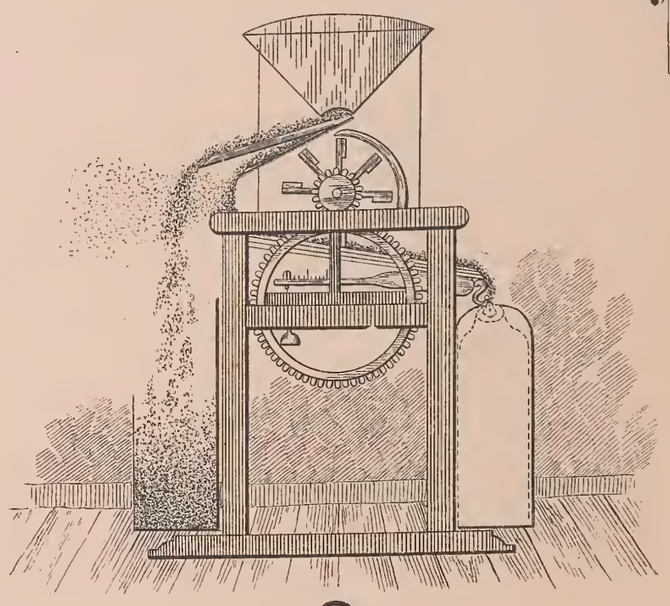
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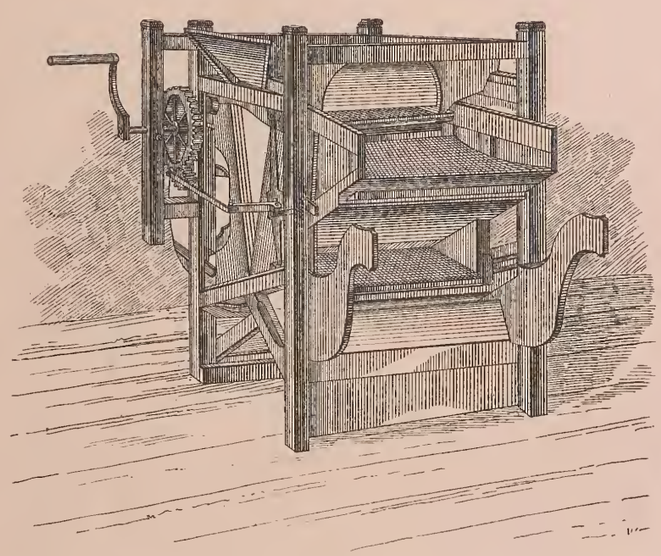
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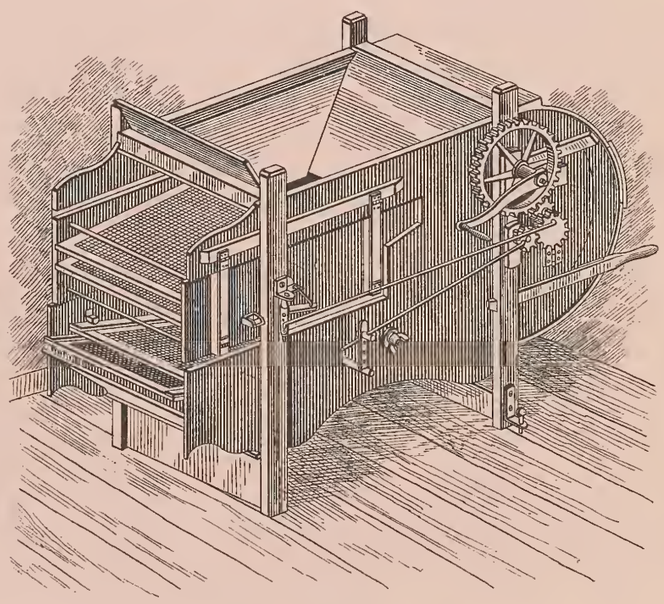
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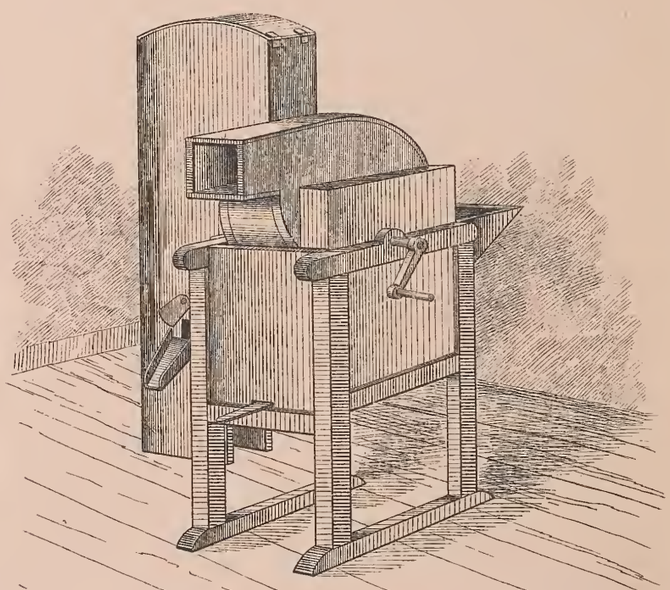
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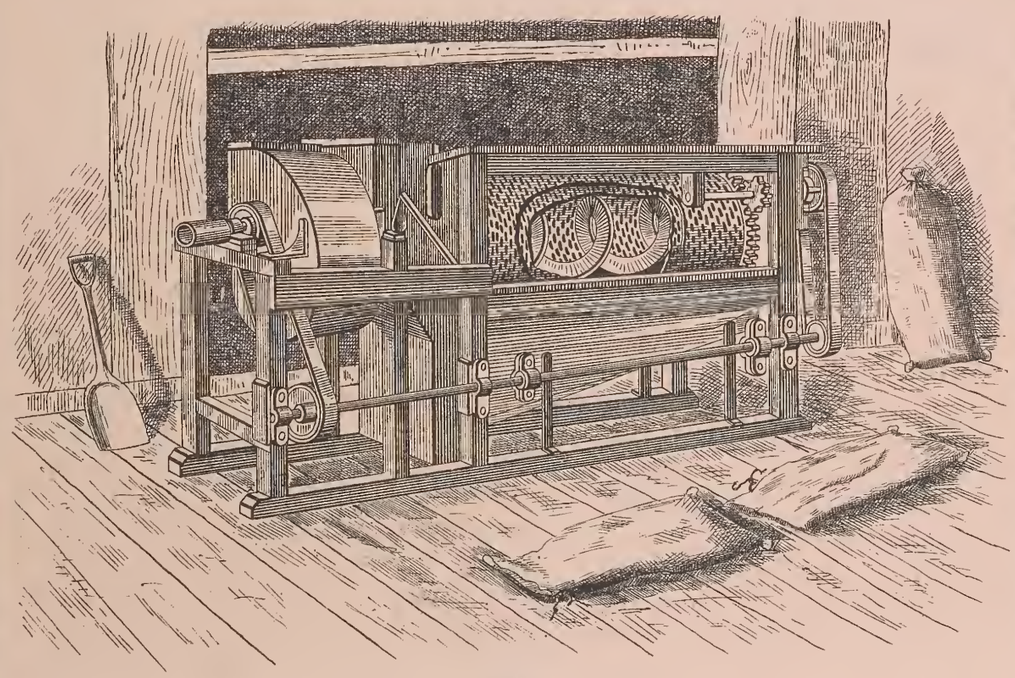
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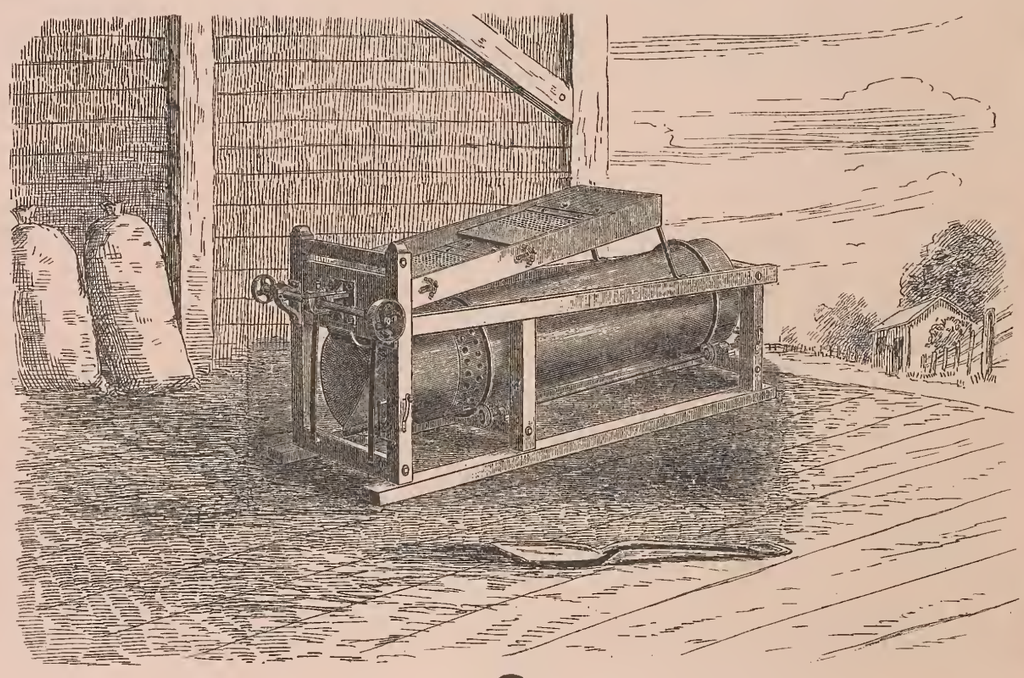
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8

WINNOWING AND SIFTING GRAIN.

WINNOWING AND SIFTING GRAIN.

No. 1. Primitive Winnowing, Egypt—1500 B. C.
2. " " Rome—100 B. C.
3. English Fanning Mill—A. D. 1775.
4. U. S. Patent, Fanning Mill—A. D. 1829.
5. " " " " —A. D. 1879.
6. " " Air Separator—A. D. 1881.
7. " " Rolling Screen—A. D. 1884.
8. " " Cockle Machine—A. D. 1884.

The winnowing of grain is early mentioned in Sacred History. "The oxen likewise and the young asses that ear the ground shall eat clean provender, which hath been removed with the shovel and with the fan. (Isaiah xxx, 24.) "Like as grain is sifted with a sieve." (Amos ix, 9.)

The oldest representations that we have of the process of winnowing is on the Egyptian tombs, where men with scoops are throwing the grain up in the air so that the passing wind may drive off the chaff.

The Egyptians used sifters made of papyrus, the ancient Spaniards of flax, and the Gauls invented sieves of horse hair.

In Britain the use of the hand sieve riddle was the only method employed for dressing grain until the last century.

We derive the winnowing machine from Britain, which country obtained it from Holland. In 1710 it was introduced into Scotland by Meikle, the father of Meikle who invented the thrashing machine.

The English word is derived from the idea of making an artificial blast by means of a fan, and the specific mechanical purpose is to separate grain from chaff by a blast of wind acting upon the latter, which is lighter than the grain.

It is among the histories of the machine that when it was introduced into Scotland certain sensitive persons pronounced it an impious device, as "It raised a wind when the Lord had made a calm." This is but another form of the opposition which met Kepler and Galileo.

Gooch, of England, in 1800, invented the more modern machine which embraces the important features of the rotating fan, the shaking riddle and sieves, for assorting grain and separating extraneous substances. Winnowing machines are frequently attached to thrashing machines.

Winnowing machines, oftener called "fanning mills" in this country, are machines in which grain, accompanied by chaff, dirt, cockle, grass, seeds, dust and straw, is subjected to a shaking action, or riddled and sieved in succession. An artificial blast of wind is driven against it on and through the sieves as it falls.

WINNOWING AND SIFTING GRAIN.

1,038 Patents Granted by the United States.

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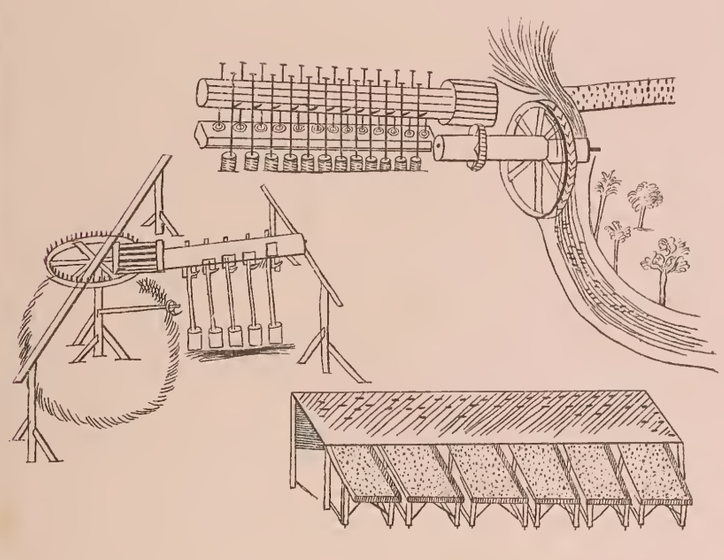
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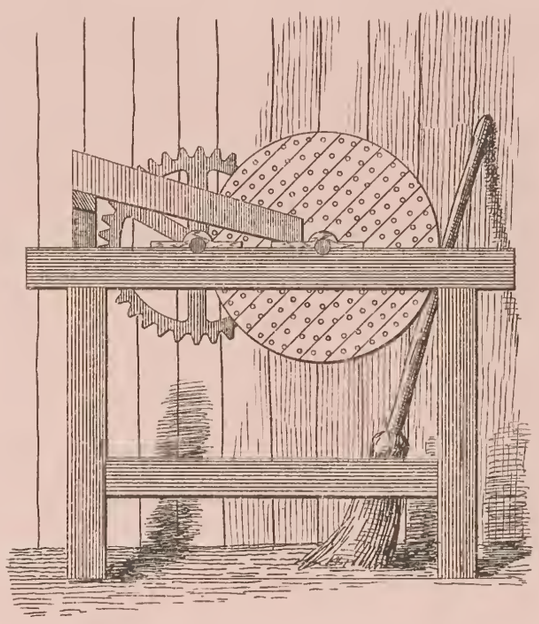
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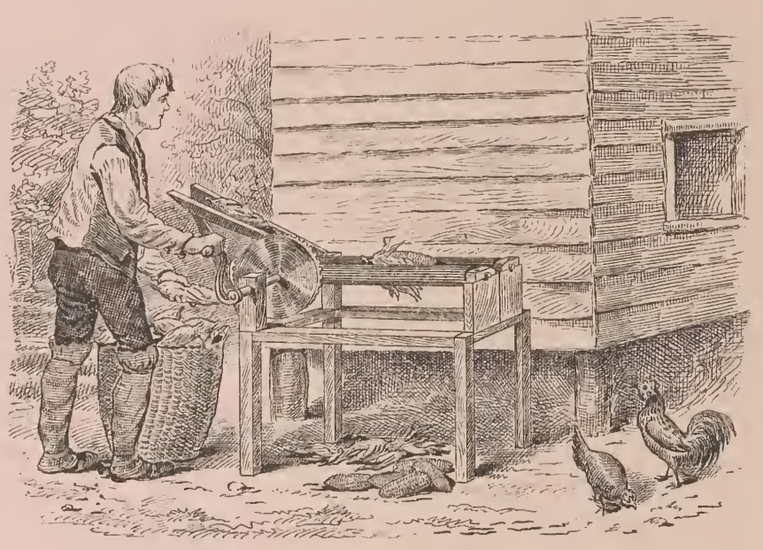
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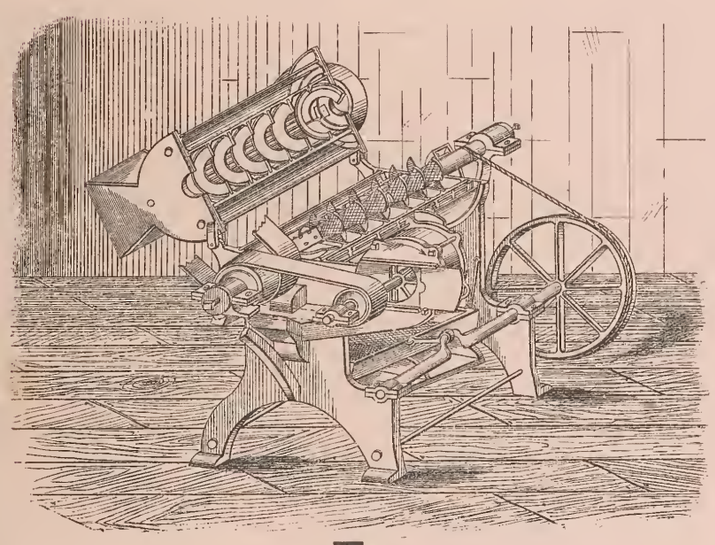
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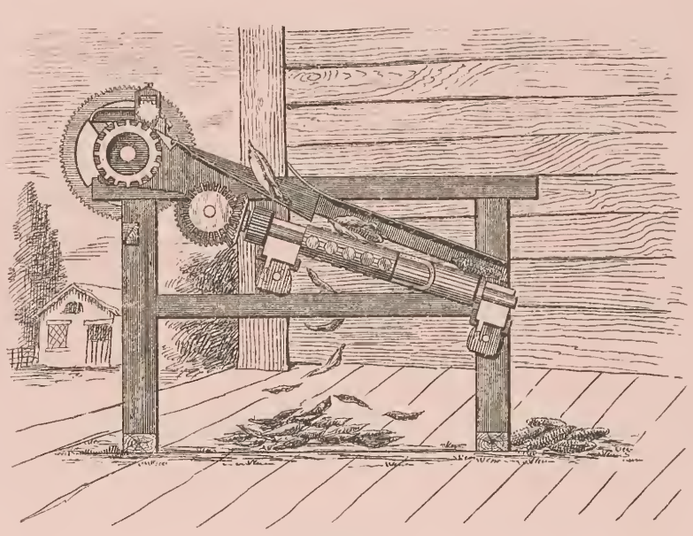
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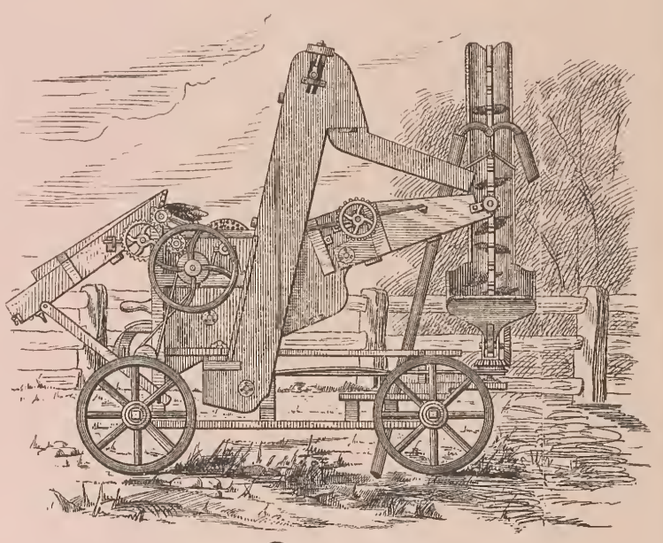
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9

CORN HUSKERS, SHELLERS, AND HOMINY MAKING.

CORN HUSKERS, SHELLERS, AND HOMINY MAKING.

No. 1. Primitive Corn Husker.
2. " Hominy Mortar.
3. " Corn Sheller.
4. English Hominy Mill—A. D. 1715.
5. U. S. Patent, Corn Sheller—A. D. 1815.
6. " " " Husker—A. D. 1837.
7. " " Hominy Machine—A. D. 1868.
8. " " Corn Sheller—A. D. 1882.
9. " " Husker—A. D. 1883.

The North American Indians pounded their maize in mortars, to make a coarse meal or hominy.

Some corn husking machines operate upon the corn in the field to husk it off the stalk; in others the ear is simply jerked from the stalk, and the machine tears off the husks from the ears.

In the hominy mill or machine the corn is subjected to a grating or beating action, which removes the cuticle and the germ, and by persistent and sufficiently energetic action, may break the grain as small as may be wanted. The sizes are graded by sifting.

It is said that the old hand process of shelling corn would require the entire population of the United States 6 days in the week—100 days per year—to shell the corn crop.

The cultivating and milling of rice in Louisiana gives employment to a large percentage of the population. There are about 900 rice plantations in the State. New Orleans has twelve mills, with a capacity for cleaning 275,000 barrels per annum.

AGRICULTURAL IMPLEMENTS.

1,943 Manufactories in the United States.

	1860	1880
Capital Invested,	$11,477,239.00	$62,109,668.00
Value of Productions,	17,599,960.00	68,640,486.00
Wages Paid,	5,080,549.00	15,359,610.00
Hands Employed,	14,814	39,480

SUB CLASS.

CORN HUSKERS, SHELLERS, AND HOMINY MAKING.

Capacity—	Primitive Mode.	Present Machine.
Bushels per day,	10	1,000
Hands Employed per day,	1	1

682 Patents Granted by the United States.

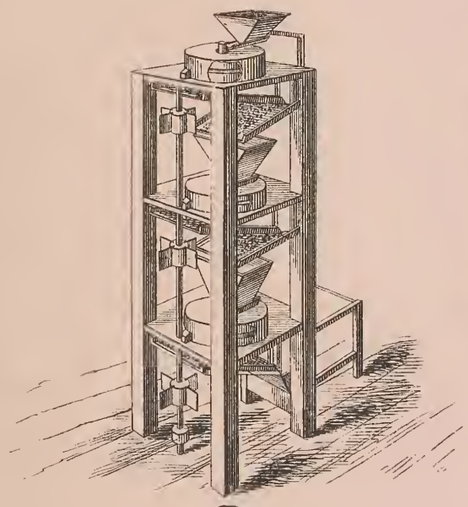
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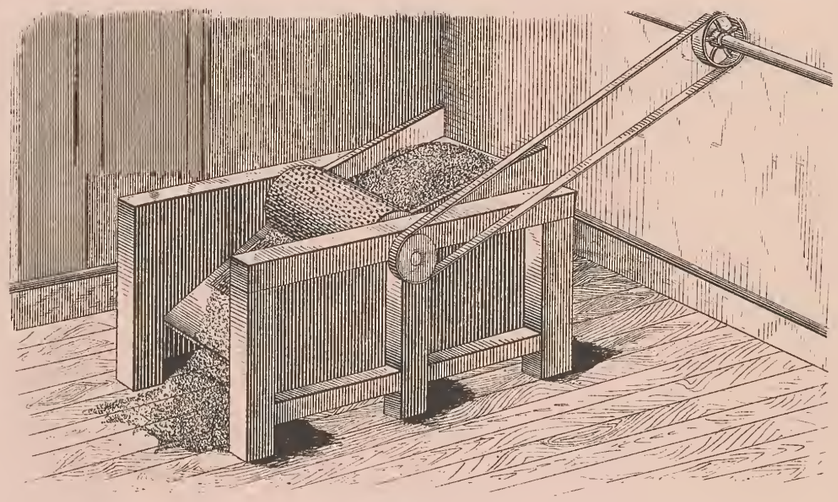
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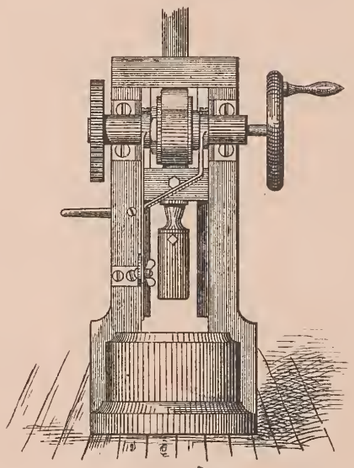
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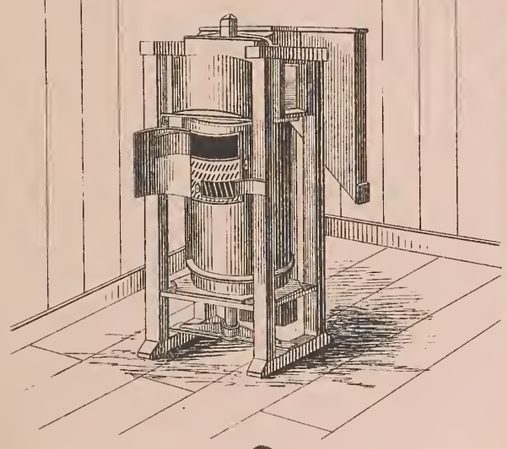
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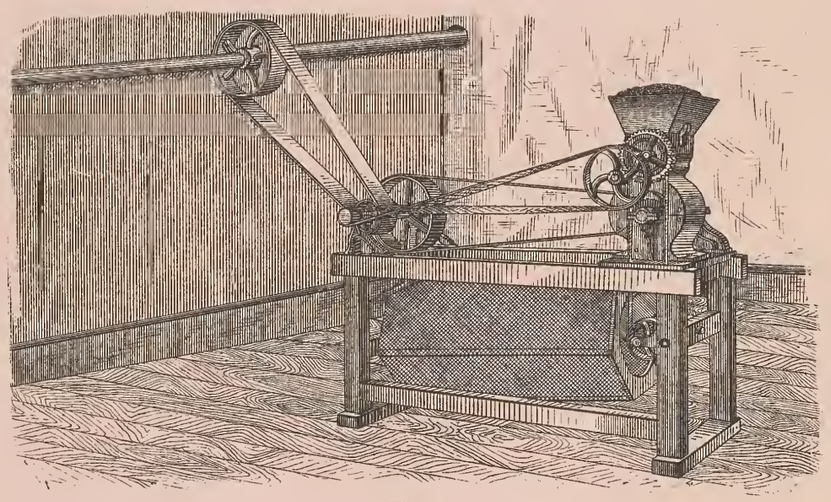
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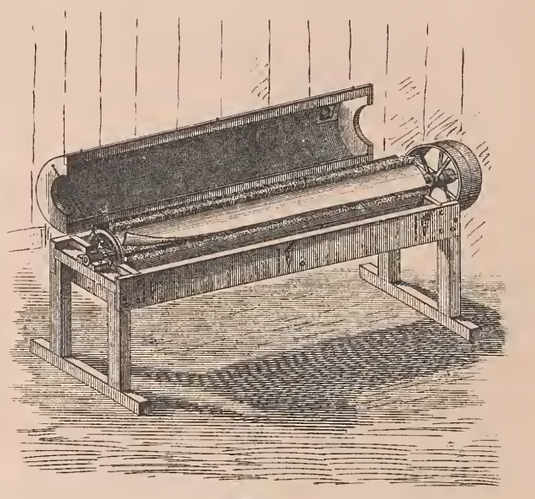
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8

WHEAT, RICE AND COTTON SEED HULLERS.

WHEAT RICE AND COTTON SEED HULLERS.

No. 1. Primitive Rice Mortar.
2. Chinese Rice Mortar.
3. U. S. Patent, Wheat Huller and Smutter—A. D. 1832.
4. " " Cotton Seed Huller—A. D. 1834.
5. " " Rice Mortar—A. D. 1878.
6. " " Wheat Huller and Smutter—A. D. 1883.
7. " " Cotton Seed Huller—A. D. 1884.
8 " " Rice and Grain Scourer—A. D. 1884.

The decortication of grain was practiced by the Romans, the whole grain being pounded in mortars with some abradant, which rasped off the cuticle.

In the time of Pliny, a mortar was employed for hulling grain, sand or pieces of brick being placed therein to assist the trituration, foreign substances, such as the husk and bran, being removed by sifting.

Mills for the manufacture of pearl barley were invented in Germany, and first used in Holland in 1660.

The Scotch pearl barley mill consists of a drum, which is rotated by suitable gearing, and within which a circular grindstone is caused to rapidly revolve. The grain is fed through a hopper, opening axially into the drum, and is removed by a sluice at its side. The drum is lined with sheet iron, perforated with small holes, which serve to remove the skin and a portion of the outer substance of the grain, bringing it to a spheroidal shape.

Other varieties of machines depend partly upon percussion.

Mills for decorticating are known in England as barley mills.

Rough rice has an outer husk and a thin cuticle which adheres to the pearly grain with great tenacity. The old mode of hulling rice was by pounding in mortars, which were made of wood, holding from one to two bushels.

Lucas, in 1780, constructed a machine driven by tide power, which operated iron shod pestles in cast iron mortars, holding five bushels each of rough rice.

Ewbanks rice huller was one of the first introduced, and was patented in England in 1819.

Steam machines succeeded the hand machines, and are now mostly used for hulling rice.

The cotton seed huller is a modern device, by which the hull of the cotton seed is rasped off and sifted from the farinaceous and oily matters, which are utilized for their oil, and the refuse is used for fertilizers.

WHEAT, RICE AND COTTON SEED HULLERS.

613 Patents Granted by the United States.

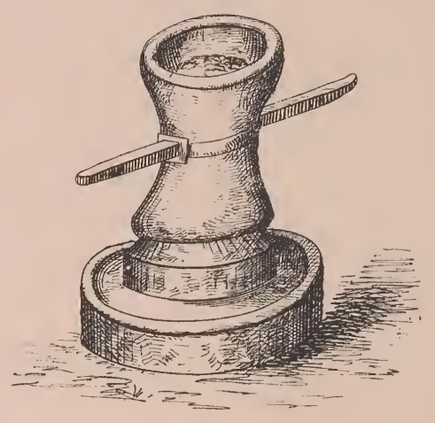
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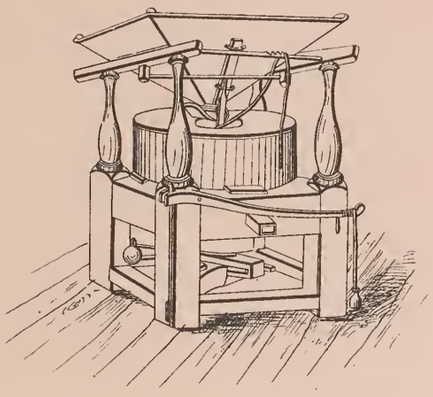
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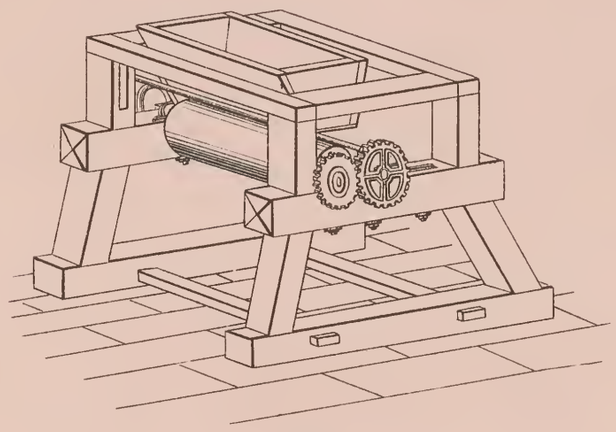
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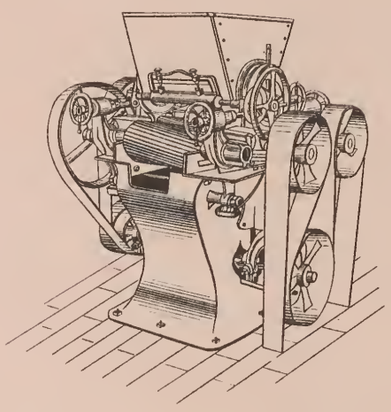
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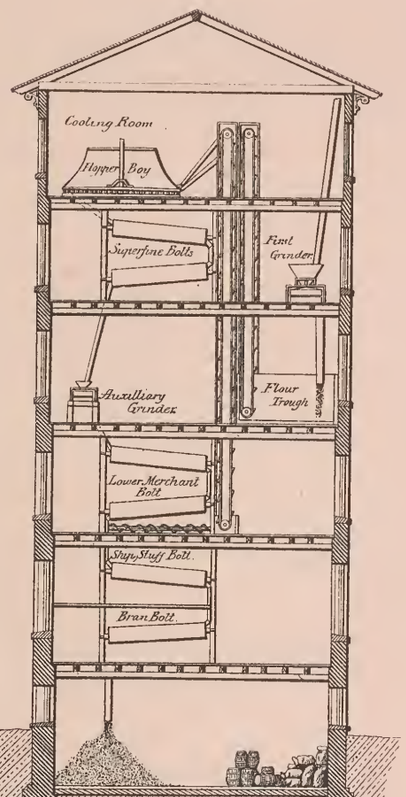
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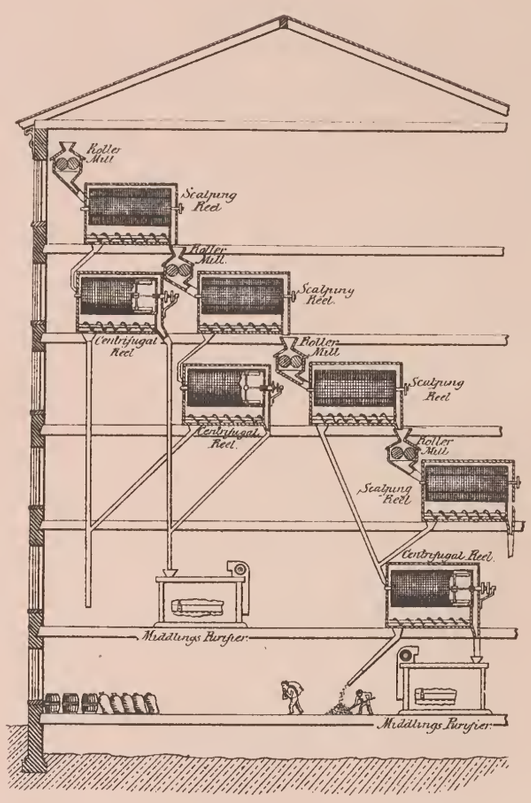
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GRAIN MILLS.

GRAIN MILLS.

No. 1. Ancient Quern (Stone Age).
2. Primitive Disk of the Scriptures.
3. Pompeian—A. D. 79.
4. U. S. Patent, Grist—A. D. 1832.
5. " " Roller—A. D. 1835.
6. " " " —A. D. 1840.
7. " " Flour—A. D. 1849.
8. " " " —A. D. 1884.

Corn mills are of the greatest antiquity. We read in the scriptures that "Abraham caused cakes to be baked for his guests of the finest meal, and their manna was ground like corn. The earliest instrument used seems to have been the mortar, a hollow stone in which the grain was pounded. In the course of time the mortar was made ridged, and the pestle notched, at least at the bottom, by which means the grain was rather grated than pounded. When the handle was added to the top of the pestle the mortar was converted into a hand mill.

Moses forbade the people to place their mills in pawn, for that, he says, "is the same thing as to take a man's life to pledge." (Deuteronomy. xxiv, 6.)

The grinding of grain was at first the employment of women, but afterwards the mills were driven by bondemen, around whose necks was placed a circular piece of wood, so that these poor men could not put their hands to their mouths or eat of the meal.

In the course of time shafts were added to the mill, that it might be driven by cattle.

The water mill appears to have been introduced in the time of Julius Cæsar. In the year 536, Belisarius, of Rome, placed boats on the Tiber, on which he erected mills that were driven by the current of the river.

Notices of water mills in France, Italy and elsewhere are numerous after the fifth century. The method of applying a sieve, in the form of an extended bag, to the works of a mill, that the meal might fall into it as it came from the stones, and of causing it to be shaken by machinery, was first made known in the beginning of the sixteenth century.

The Oliver Evans hopper boy patent, for feeding grain to the millstone, was considered of such importance by Thomas Jefferson, that he thought the patent should not be allowed, it being of such necessity to the miller.

The first steam flouring mill was the Albion, erected at Southwark, England, in 1783.

From the hand machines to the patent buhr stones, turning out hundreds of bushels of finely ground grain in a day, was a great improvement by gradual steps, but the day for grinding grain with stones has passed, and the roller crusher is now taking the place of stones in mills.

The weight of an ordinary pair of millstones is from 1,300 to 1,700 pounds. They measure about 48 inches in diameter, are about 10 inches thick, and contain from 30 to 40 buhrs.

The flour and grist mill industries of the United States aggregate a product of $505,185,712.

GRAIN MILLS.

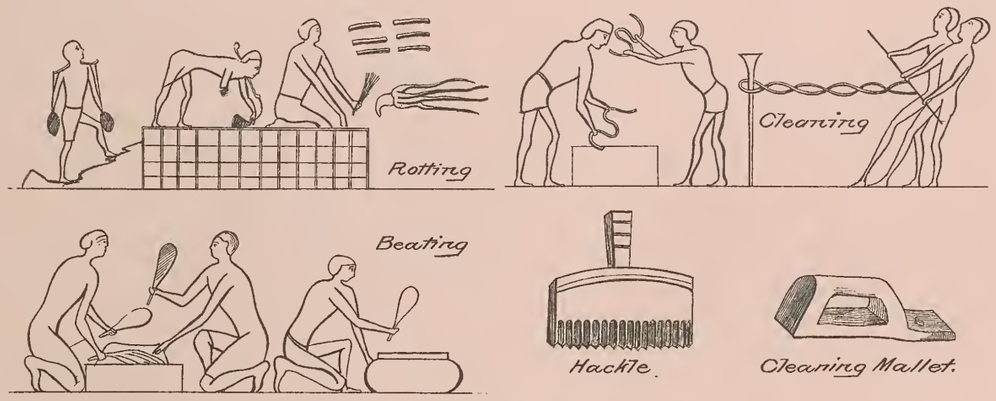
24,338 Flour and Grist Mills in the United States.

	1860	1880
Capital Invested, -	$84,585,004.00	$177,361,878.00
Value of Productions, -	248,580,365.00	505,185,712.00
Wages Paid, - -	8,721,391.00	17,422,316.00
Hands Employed, - -	27,682	58,407

	Ground in 1880.
Wheat, bushels, - - - -	304,775,737
Other Grain, bushels, - - - -	234,907,220
Total bushels, - - - -	539,682,957

1,732 Patents Granted by the United States.

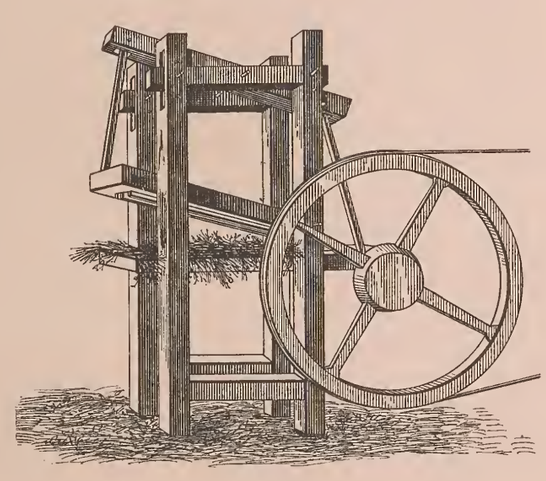
Sackett & Wilhelms Litho Co New York



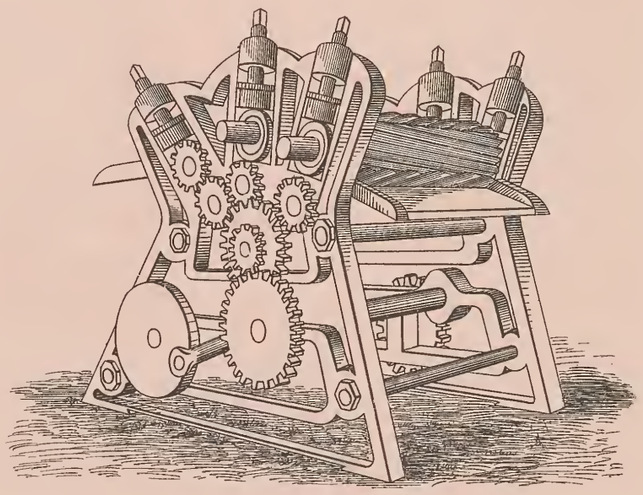
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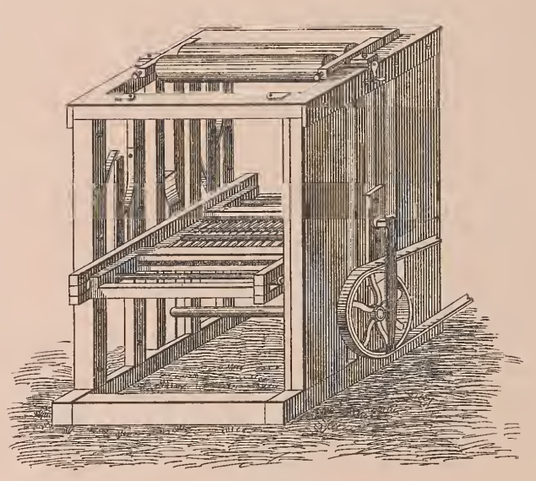
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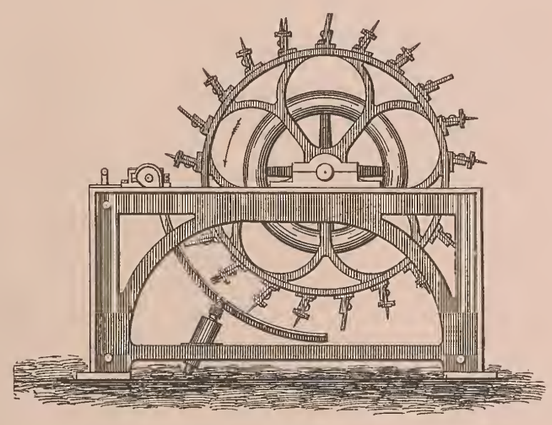
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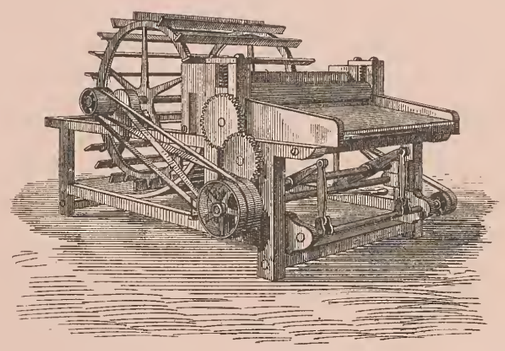
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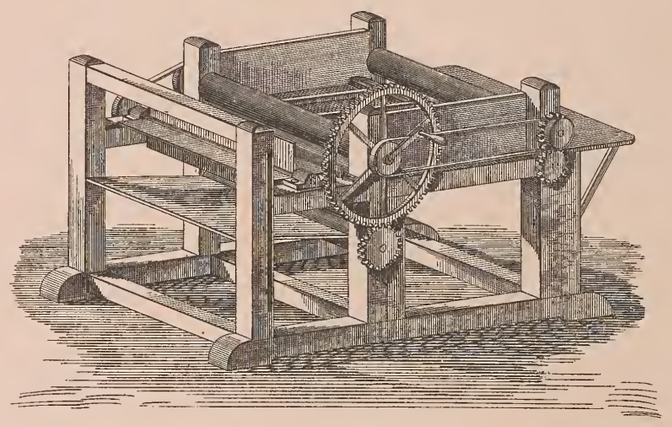
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8

HEMP AND FLAX TREATMENT.

HEMP AND FLAX TREATMENT.

No. 1. Primitive Treating Flax, Egypt—B. C. 1500.
2. Scutching Sword and Stand—A. D. 1780.
3. U. S. Patent, Hemp Brake—A. D. 1816.
4. " " " and Flax Brake—A. D. 1878.
5. " " Hackling Machine—A. D. 1879.
6. " " Fiber Cleaner—A. D. 1879.
7. " " Ramie Machine—A. D. 1879.
8. " " Breaker and Scutcher—A. D. 1880.

Hemp is not mentioned in our translation of the Hebrew, and but sparingly in the Greek classics. The Thracians made garments of hemp, which closely resembled linen. The Greeks and Romans used hemp, but never cultivated it before the Christian era. Cloth, made of hemp, became common in Europe in the thirteenth century.

In Virginia, United States, hemp was raised previous to 1648. In 1657 its culture was encouraged by the Government.

To separate the fibre, the hemp is dew-rotted or water-rotted. In the former process, the hemp is spread upon the ground in October, or a month or two later, according to the climate; when the lint readily separates upon breaking a stalk, the process, which requires about two months, is complete. In water-rotting, the hemp is immersed in water for ten days or more, according to the season. This is done in streams, in artificial pools made near the margin of a river, or in large wooden vats under cover. When rotted in vats the hemp is subjected to a partial breaking, which lessens its bulk. After the hemp is rotted and dried it is taken to the brake, which is either a rude affair worked like a flax brake, or an improved machine operated by steam, or other power. After breaking the hemp is twisted into bundles and baled for market.

The principal hemp producing countries are Russia, Italy, Holland, Turkey, Great Britain, the East Indies, and the United States.

Flax is first mentioned in the Old Testament, in Exodus ix, 31.

Flax was used to the exclusion of wool for priestly garments. Isaiah refers to the fine linen of Egypt. The manipulation of flax to render it of use was known in Egypt 1500 B. C. It was exported from Egypt to Gaul as late as the Christian era. Henry the VIII, of England, ordered it to be grown in Scotland. In 1750 a braking or scutching machine was erected and run by water power.

The first process in the preparation of flax fibre is to steep the stalks in water until fermentation takes place. This causes the glutinous matter, which binds the harl or fibrous portion to the woody core called the boon, to be decomposed, and the fibres are then set free. The water most suitable for this purpose is soft river water.

The flax is left freer from color by a stream of water flowing over the bundles than if these are steeped, as is often done, in a pool. This process is called water-retting, or rotting. The result is sometimes obtained by exposing the flax or grass plots to the dew or rain. The duration of the process is from six to twenty days. A more expeditious process was devised by Mr. R. B. Schenck, of New York, and introduced in 1847, and consists in steeping the stalk in water heated by steam pipes to a temperature of about 90 degrees Fah. The gummy matter is thus rapidly decomposed, so that in about sixty hours the operation is completed. The mucilaginous water is then drawn off, and the flax set to dry upon frames.

After the flax has been rotted and dried, it is submitted to the process called braking, by which the straws are cracked repeatedly across, the effect of which is to produce the separation of the brittle, woody portion, which falls away in pieces from the filaments when afterwards beaten by a broad, flat blade of wood in the operation of scutching.

Flax is also broken upon a large scale by machines consisting of fluted rollers variously contrived. Other labor saving machines, with rotating blades, have been applied to the process of scutching. One end of the bundle being hatchelled, it is turned round and the other treated in the same way.

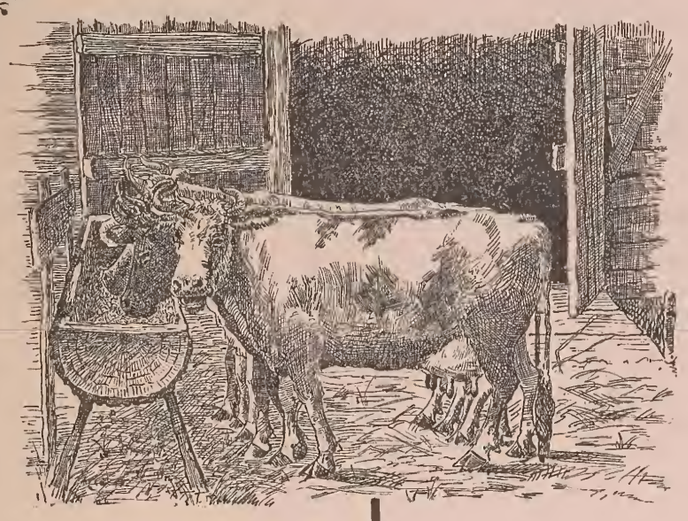
HEMP AND FLAX TREATMENT.

Hemp and Flax Produced:

	1880
Hemp, tons,	5,025
Flaxseed, bushels,	7,170,951
Flax Straw, tons,	421,098
" Fiber, pounds,	1,565,546

338 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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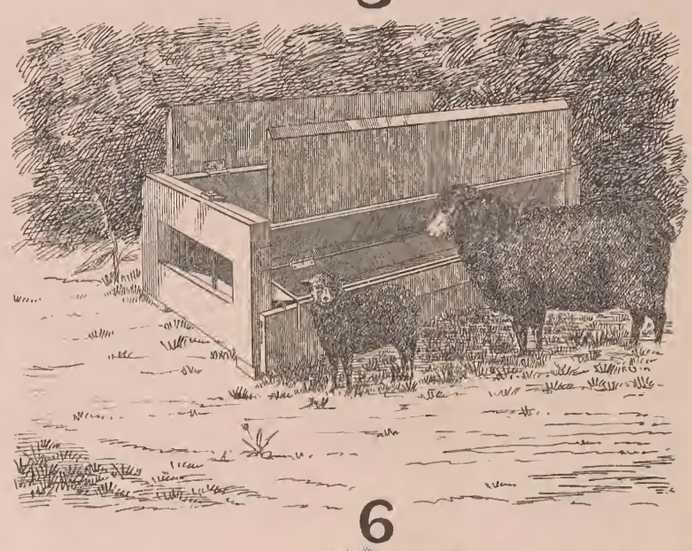
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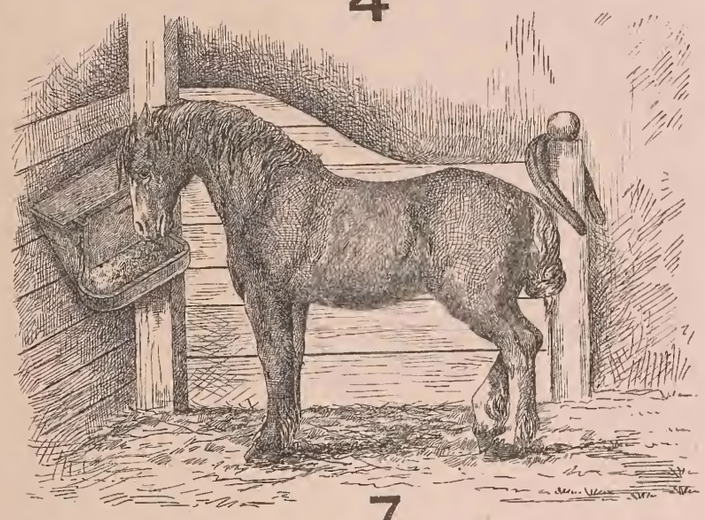
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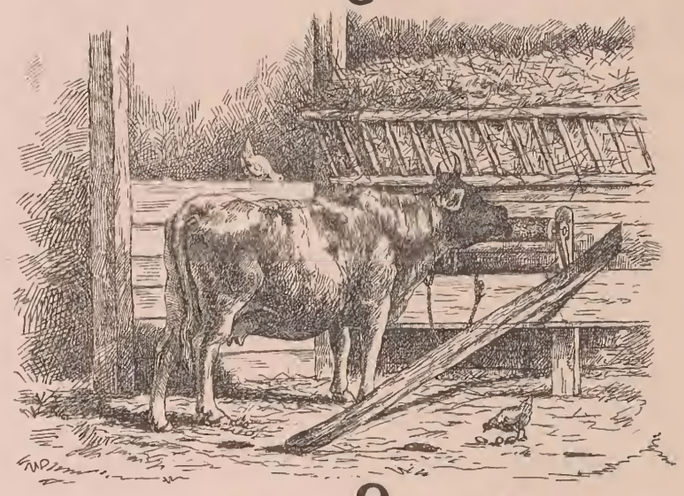
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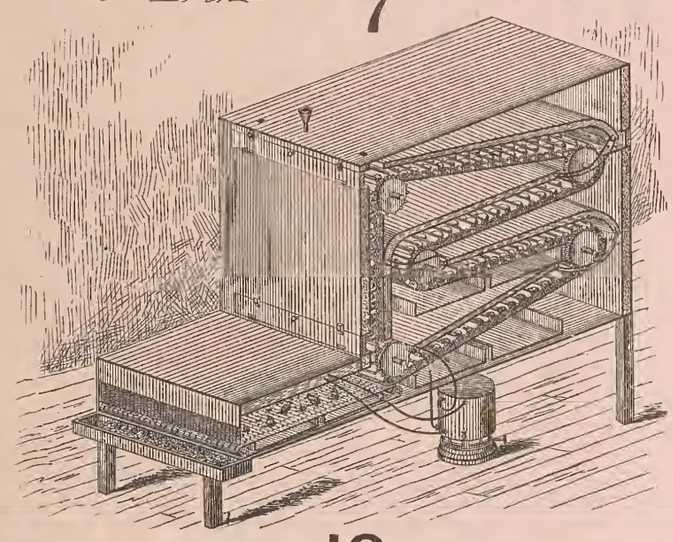
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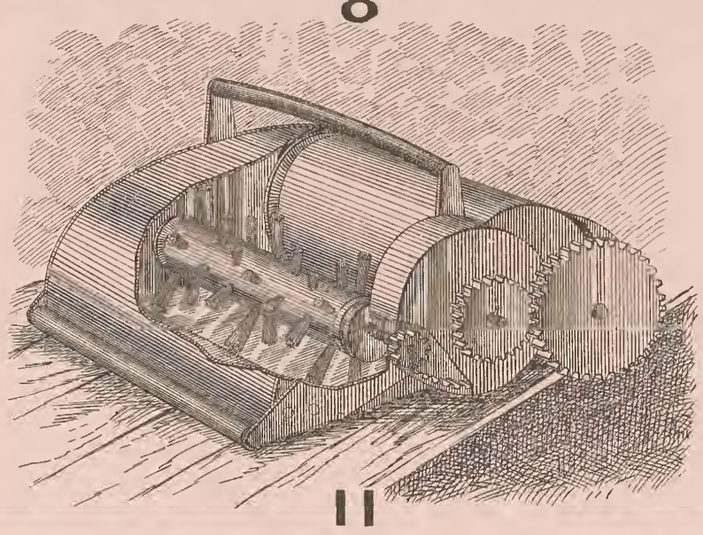
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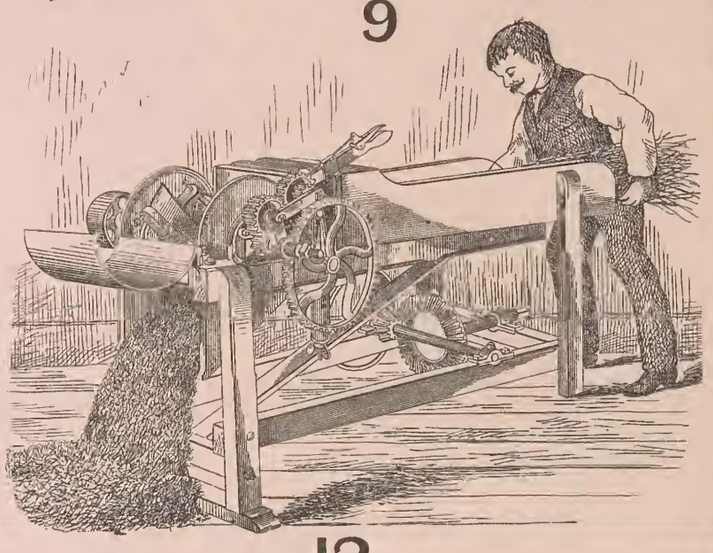
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CARE OF STOCK.

CARE OF STOCK.

No. 1. Feeder.
2. Salt Feeder.
3. Grooming
4. Hen's Nest.
5. Egyptian Incubator.
6. U. S. Patent, Sheep Rack—A. D. 1881.
7. " " Manger—A. D. 1882.
8. " " Grooming—A. D. 1882.
9. " " Salt Feeder—A. D. 1883.
10. " " Incubator—A. D. 1883.
11. " " Horse Brush—A. D. 1884.
12. " " Fodder Cutter—A. D. 1884.

The care of stock is almost as old as the human race.

In the sculpture of Nimrod is represented a tent within which is a groom currying a horse.

The Arabians are noted for the care they take of their horses, and the result of years of kindness and attention has produced a breed whose beauty, strength, swiftness and endurance have made it both famous and valuable.

The Hebrews cut straw and grain in the sheaf for food.

Hohlfield, of Saxony, about 1711, invented a straw chopper.

The chaff cutter of the last century was a trough, in which the hay or straw was pushed along by a fork so as to be exposed to a knife at the end of the trough, and was oscillated by hand.

Horses and oxen are fed in a trough arranged in their stalls. The best stock breeders allow each animal a separate trough for food. Their food is now prepared for them by being cut up in different kinds of machines. Fodder is cut very fine. Corn is taken off the ear and the grains are cut in two. Meal for milch cows is soaked in hot water.

Sheep are kept in warmer quarters than formerly, and fed in a way which has greatly increased the quality and quantity of their wool.

A sheep rack has been invented which is of portable wrought iron and is mounted on four wheels. It has a wrought-iron hay rack in the middle, a trough at each side, doors at the ends and a corrugated iron roof with eave gutters.

A sheep shearing machine has also been invented, which greatly facilitates that unpleasant operation.

A device known as a stock feeder automatically supplies feed to stock in limited quantities at certain times. It is an ingenious, but not commonly adopted, device, attached to some mangers.

The eggs referred to in the Old Testament were those of wild birds, whilst those in the New Testament were ordinary hens' eggs.

The domestic fowl of to-day is a native of India, and is not mentioned in the Old Testament. It was known in Palestine at the Christian era, and is supposed to have been introduced by the Romans into the countries they subjugated. They were common in Greece.

Egg hatching in Egypt is conducted largely by the Copts, an ancient Egyptian race. For such purposes they use a building containing 12 or 24 ovens, holding 150,000 eggs.

The proprietor of an oven collects the eggs from the peasants in the vicinity. The eggs are placed on mats strewn with bran, and are changed to positions nearer to, or further from, the heat, till the expiration of six days, four more days in the warmest position, and five days in a closed chamber. They are frequently changed during the next 5 days, outside air being carefully excluded.

The ancient Egyptian incubators are mentioned by Aristotle, Deodorus, and others.

Bounewain's incubator, invented in 1777, was heated by hot water. Tubes run back and forth through the machine containing the hot water, above which the eggs are placed.

In the year 1831 there were 105 of these establishments in Lower Egypt using 19,000,000 eggs, of which 13,000,000 produced chickens, thus saving the valuable time of 1,500,000 hens for three weeks of inactivity and several succeeding weeks of care of their broods.

Poultry raising may be classed as one of the accompaniments of a stock farm. The raising of chickens, in particular, has become an important industry, and modern science has contributed no little to the increase in the number of chickens annually hatched.

More modern inventors use various methods of heating.

The following table shows the length of time required for hatching eggs: Swan, 42 days; goose, 35 days; turkey, 28 days; peafowl, 28 days; duck, 28 days; common hen, 21 days; pigeon, 14 days; canary birds, 14 days.

Hens' eggs are hatched by being kept at a temperature of 104° for three weeks.

It is estimated that 50,000,000 eggs are consumed daily in the United States.

456,910,916 dozens of eggs were produced in the United States in the year 1880

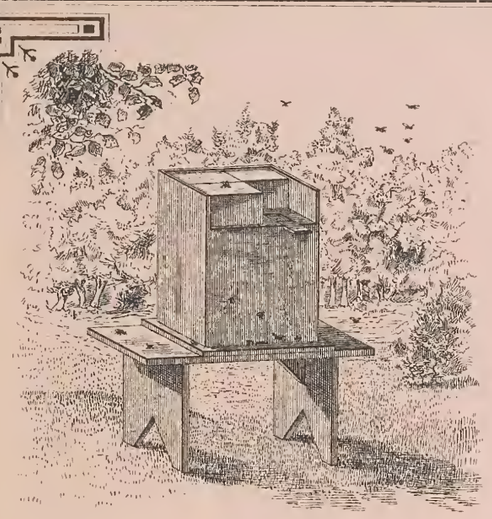
CARE OF STOCK.

Live Stock on Farms in the United States.

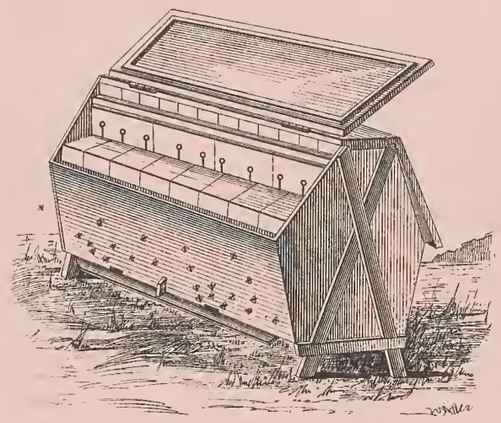
	1860	1880
Horses,	6,249,174	10,357,488
Mules and Asses,	1,151,148	1,812,808
Working Oxen,	2,254,911	933,841
Milch Cows,	8,585,735	12,443,120
Other Cattle,	14,779,373	22,488,550
Sheep,	22,471,275	35,192,074
Swine,	33,512,867	47,681,700
Live Stock on Ranches and Ranges.		
Cattle,	Not reported.	3,750,022
Sheep,	" "	7,000,000
Swine,	" "	2,090,970
Value,	$1,089,329,915.00	$1,500,384,707.00

1,430 Patents Granted by the United States.

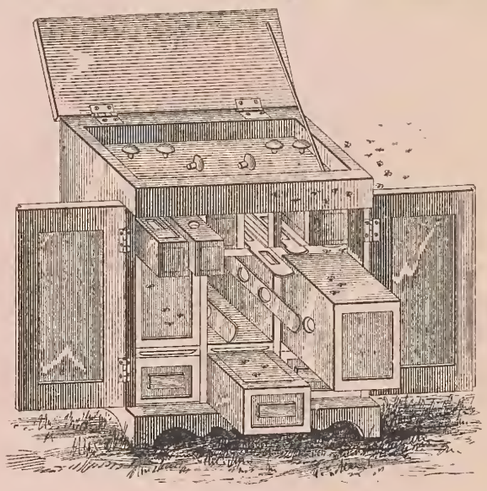
Sackett & Wilhelms Litho Co New York



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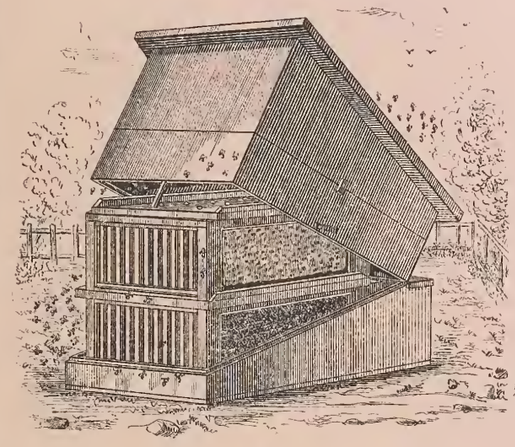
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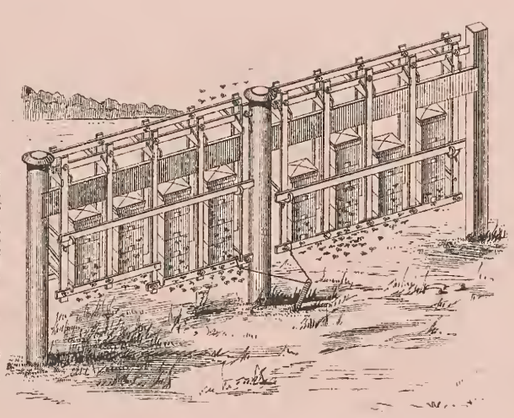
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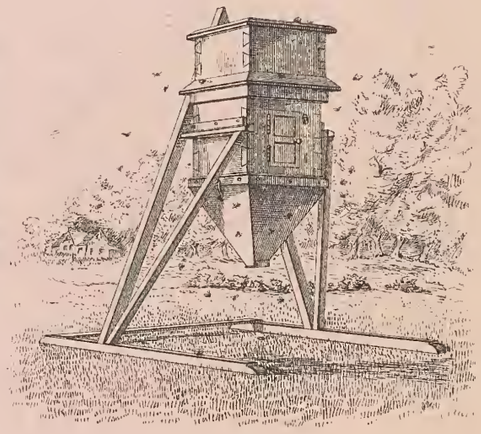
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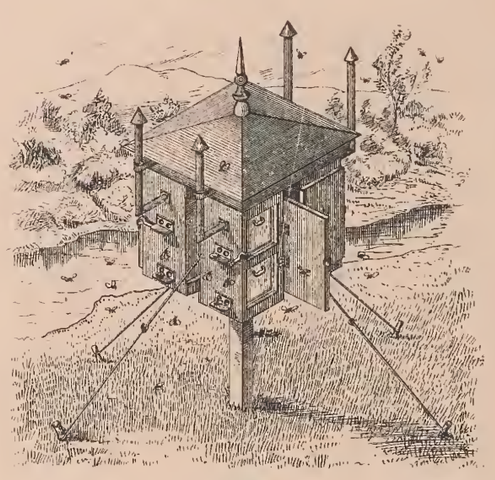
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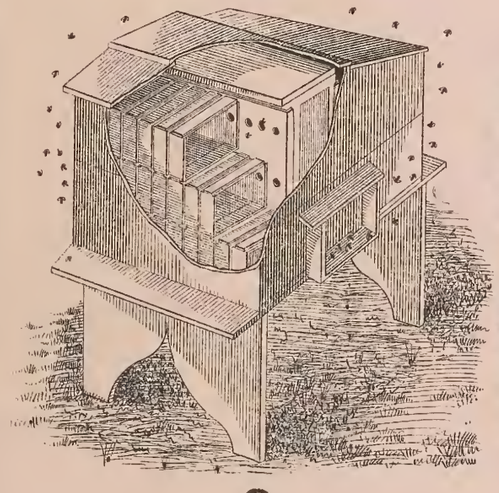
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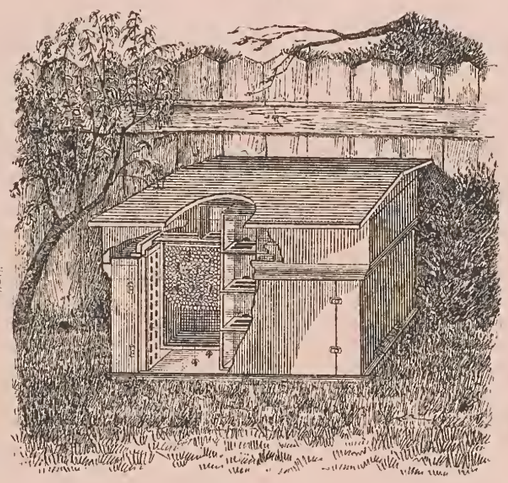
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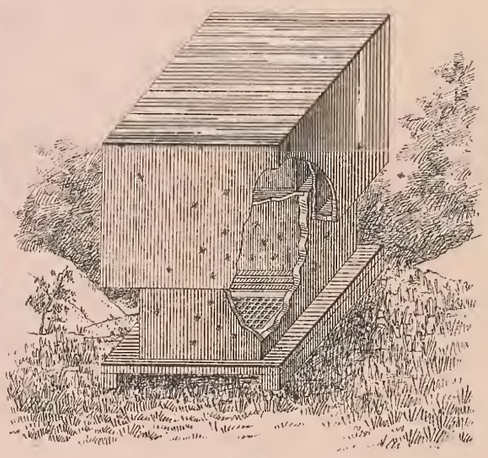
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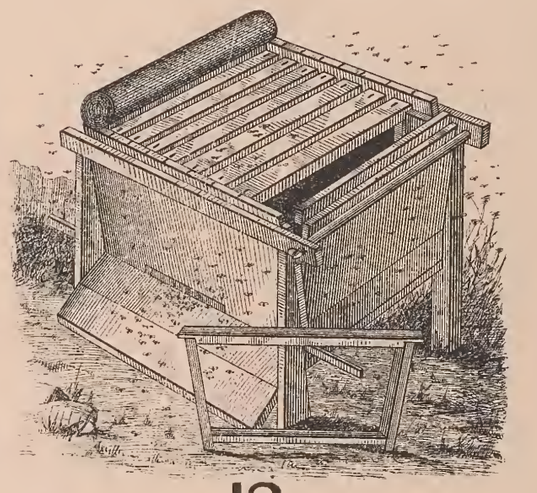
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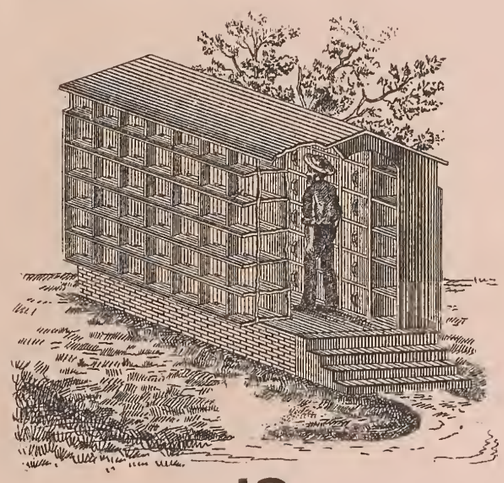
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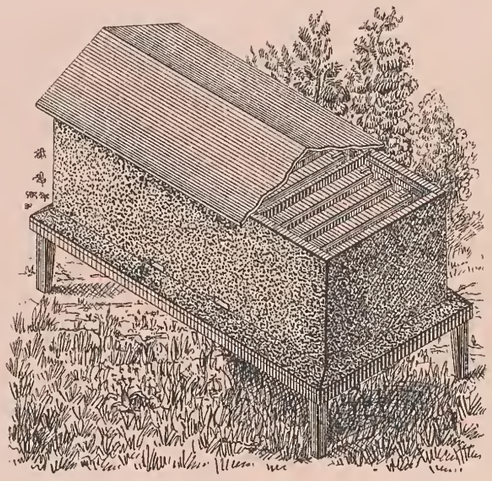
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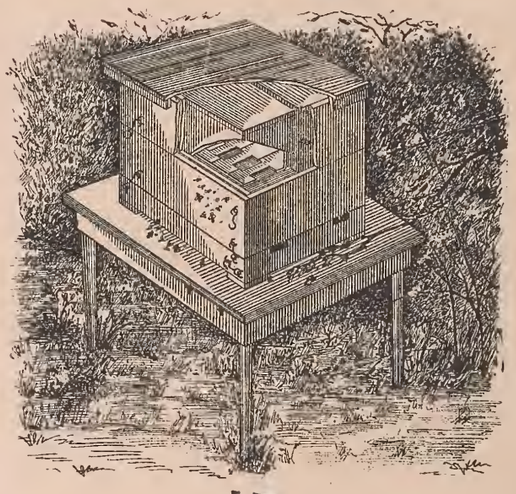
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BEE HIVES AND HOUSES.

BEE HIVES AND HOUSES.

No. 1. U. S. Patent, Compartment Hive—A. D. 1830.
2. " " Bee House—A. D. 1836.
3. " " Multiple Hive—A. D. 1842
4. " " Ventilator Hive—A. D. 1843.
5. " " Hive—A. D. 1852.
6. " " Hive Supporting Frame—A. D. 1860.
7. " " Truncated Hive—A. D. 1869.
8. " " Bee House—A. D. 1871.
9. " " Compartment Hive—A. D. 1872.
10. " " Bee Hive—A. D. 1877.
11. " " " " —A. D. 1877.
12. " " Frame Spacing Bars—A. D. 1878.
13. " " Apiary—A. D. 1878.
14. " " Moth Killing Hive—A. D. 1879.
15. " " Compartment Hive—A. D. 1884.

Varro, 50 B. C., recommends that hives be made of basket work, wool, bark, hollow trees, pottery or reeds, also of transparent stone, to enable persons to see the bees at work.

Cork hives are in use in some parts of Europe, and in Greece and Turkey earthenware hives are used.

The ancient English hives were baskets of unpeeled willows.

Pepys, in his diary, 1665, refers to glass hives.

In 1792 movable comb hives were invented. In Egypt they transport bees in hives on boats from place to place along the Nile, according to the succession of flowers. This custom has long been in vogue in Persia, Asia Minor and Greece, and in Scotland when the heather is in bloom. In Poland bees are transported from their winter quarters to their summer pastures, and back again in winter.

Greece is said to produce the greatest quantity of honey. Near Attica it is estimated that there are twenty thousand hives.

A floating bee house has been constructed for use on the Mississippi river, large enough to accommodate two thousand hives. It is to be towed up the river from Louisiana to Minnesota, keeping pace with the blossoming of the flowers, thus stimulating the honey making ability of the bees. It is possible that honey bee ships might advantageously be sent out in winter to the West Indies to cruise for honey after the manner above described.

There are over two million bee hives kept by bee keepers in the United States.

BEE HIVES AND HOUSES.

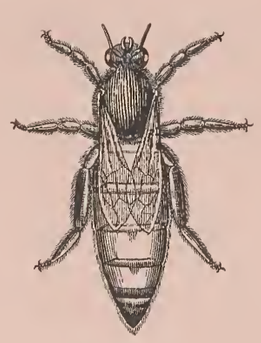
	1860	1880
Honey produced, pounds,	23,366,357	25,743,208
Wax "	1,322,787	1,105,689

866 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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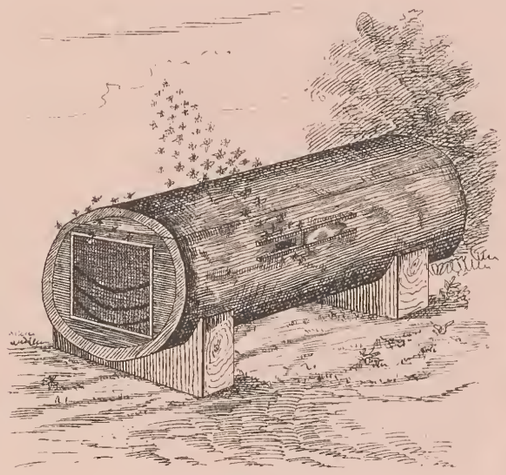
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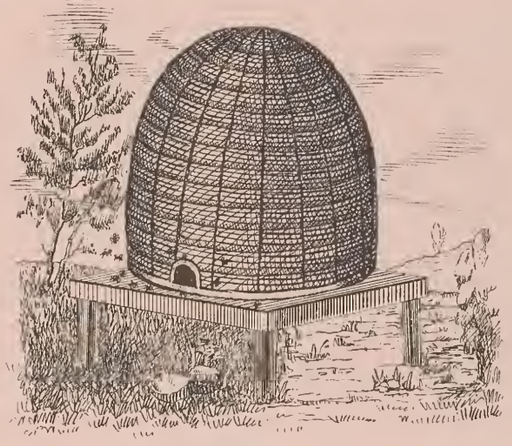
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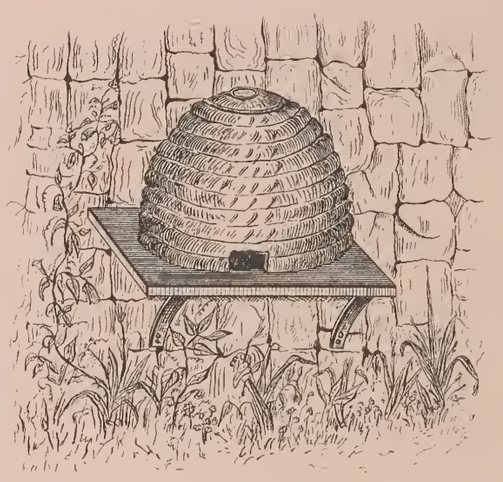
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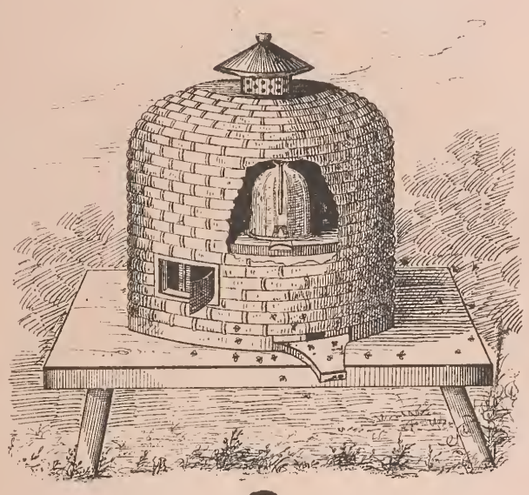
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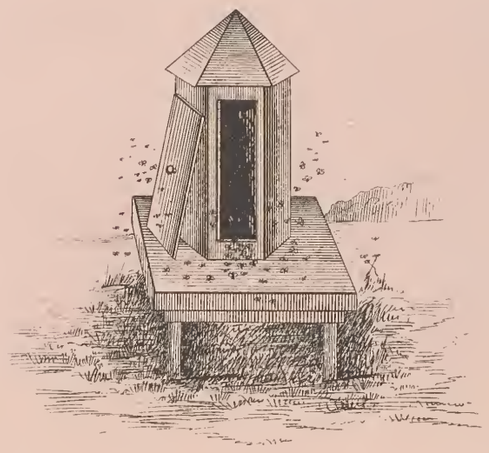
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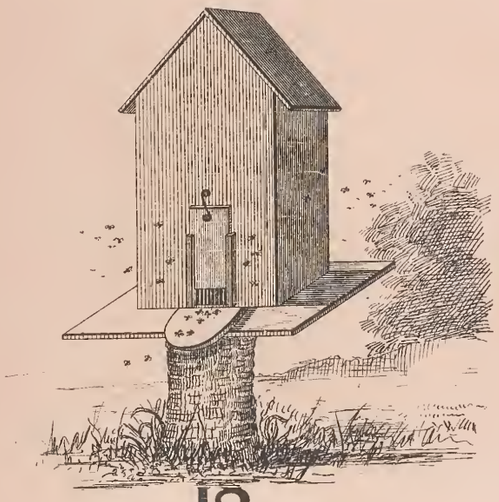
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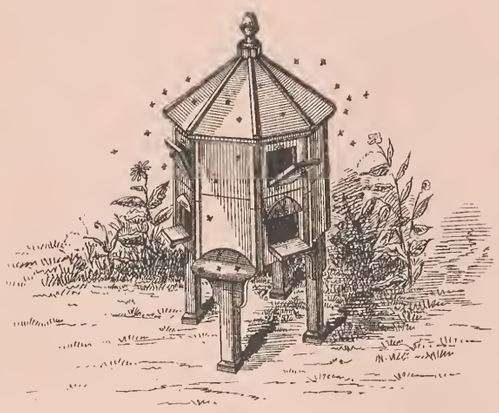
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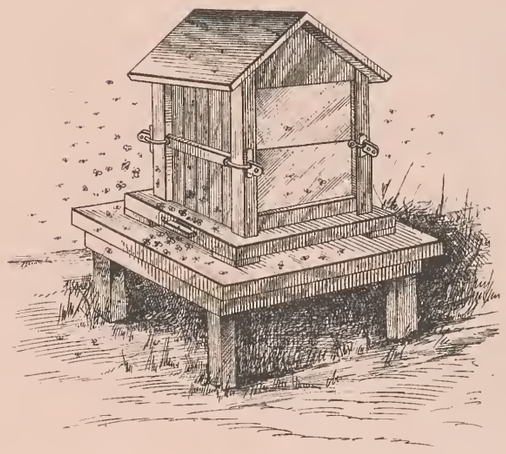
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BEE KEEPING.

BEE KEEPING.

No. 1. Worker.
2. Queen.
3. Drone.
4. Bee Tree.
5. Bee Log.
6. Pompeian Hive.
7. Straw Hive.
8. Metal and Cork Hive.
9. Upright Gum.
10. German Hive.
11. Barrel Hive.
12. Upright Box Hive.
13. Octagonal Hive.
14. Observatory Hive.
15. Multiple Hive.

Samson found bees in "the land that flowed with milk and honey." Under the Levitical law honey was prohibited as an offering on the altar; the first fruits were presented for the use of the priests.

Honey was a favorite article of food in ancient Egypt.

Eremetius wrote a poem on bees, 741 B. C.

The Indians call the bee "the white man's fly."

The domestic bee was not introduced west of the Mississippi river before 1797, nor in California before 1850.

The first importation of Italian bees into the United States was in 1860. A single colony of bees has been known to give a profit of thirty-five dollars in a season.

There are two hundred and ninety-two species of the apis genus.

Reliable authorities place the number of colonies of bees in the United States, in 1881, at three million, and the honey production for the year at more than two billion pounds.

BEE KEEPING.

	1860	1880
Honey produced, pounds,	23,366,357	25,743,208
Wax " "	1,322,787	1,105,689

866 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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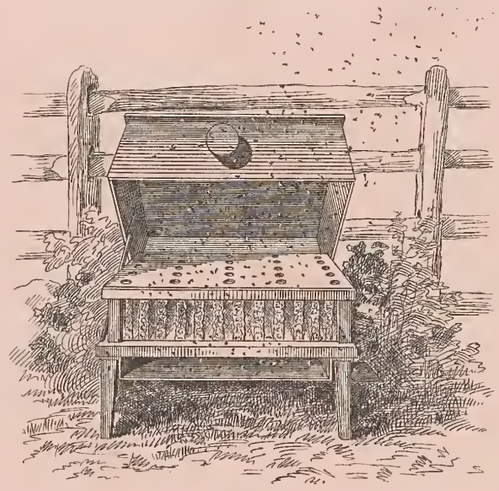
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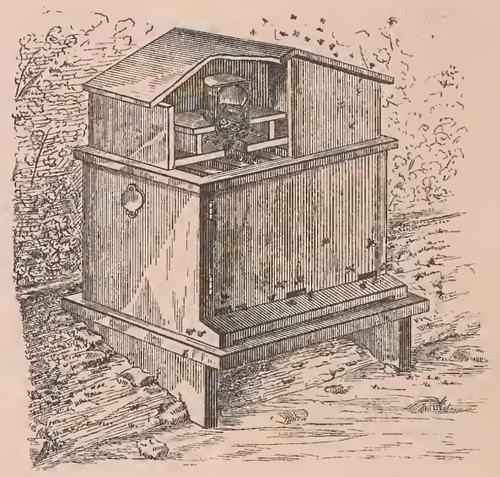
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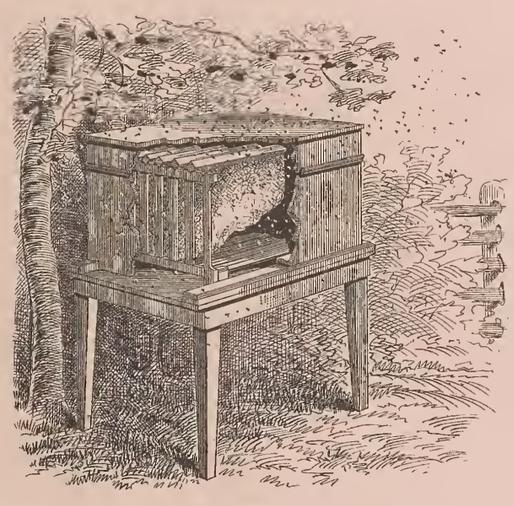
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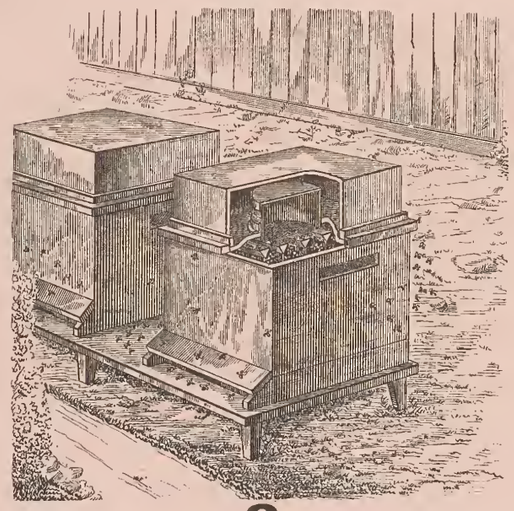
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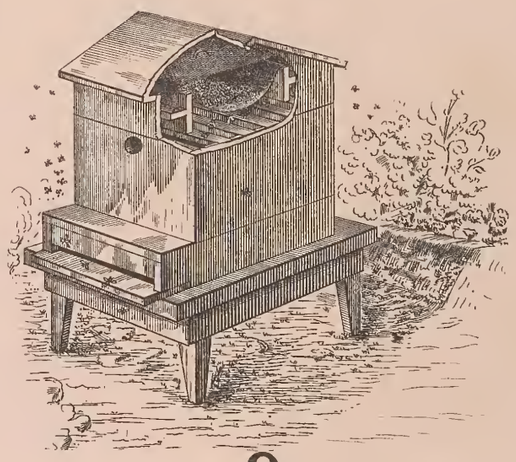
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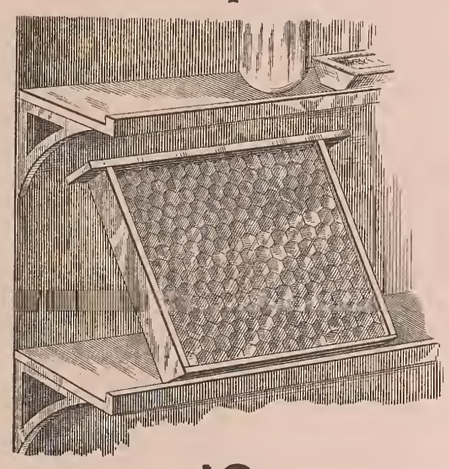
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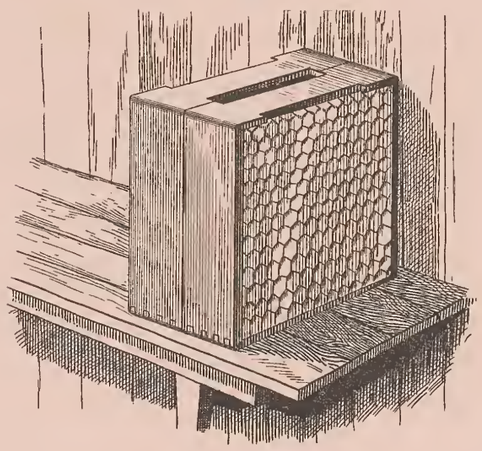
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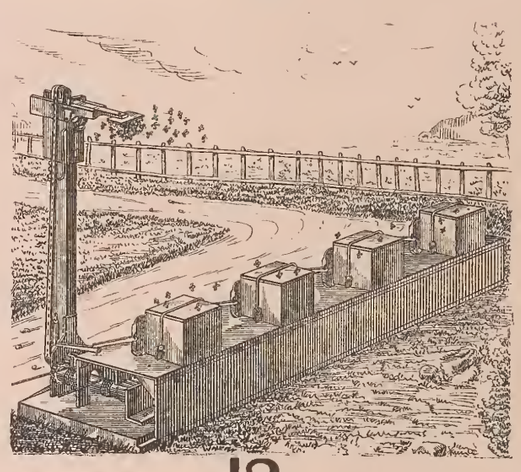
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BEE SWARMING, HIVING AND FEEDING.

BEE SWARMING, HIVING AND FEEDING.

No. 1. Bee Swarm.
2. " Swarming.
3. " Hiving.
4. Securing Swarm.
5. U. S. Patent, Comb Frame—A. D. 1852.
6. " " Bee Feeder—A. D. 1867.
7. " " Comb Bar—A. D. 1868.
8. " " Bee Feeder—A. D. 1874.
9. " " " " —A. D. 1878.
10. " " Artificial Comb—A. D. 1881.
11. " " " " —A. D. 1882.
12. " " Hiving—A. D. 1884.

In Central America, wild swarms of bees which establish themselves in the hollow limbs of trees, are removed to the porches of houses and there suspended by thongs.

In the United States, at the south and west, where bee hunting is extensively followed, the method of their capture is uniform and simple. The hunter takes into the woods a box containing about one-half a pound of honey, and if the bees will not come to the honey one or two are caught and brought to the box. As the bees collect around the box some fly away loaded with the honey. The bee always rises and circles around until it sees some familiar landmark; the hunter observes the line of its flight, and follows until the tree is found.

Recently four colonies of bees were shipped from California to New Zealand. Each of the boxes was provided with an attachment at one side, carrying a sponge, by means of which the bees were to be supplied with fresh water and the atmosphere of the hive kept sufficiently humid. Ventilation was provided for by openings covered with wire cloth, and fitted with sliding doors. A wire covered cage was attached to each hive for a cooling place for the bees in case the interior of the hive became too warm.

The food of bees is principally honeyed fluid and pollen; they also eat sirup, treacle and other saccharine substances.

BEE SWARMING, HIVING AND FEEDING.

	1860	1880
Honey produced, pounds,	23,366,357	25,743,208
Wax " "	1,322,787	1,105,689

866 Patents Granted by the United States.

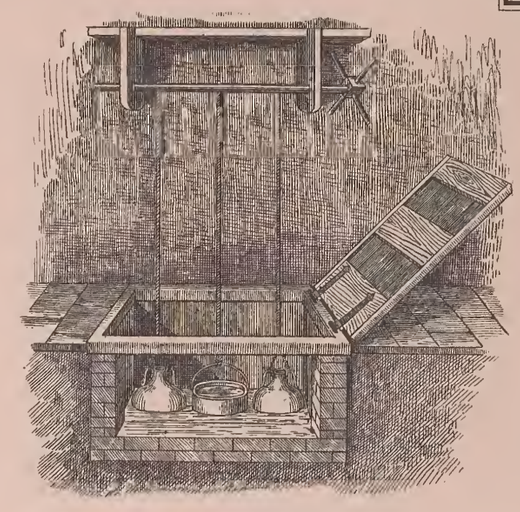
Sackett & Wilhelms Litho Co New York



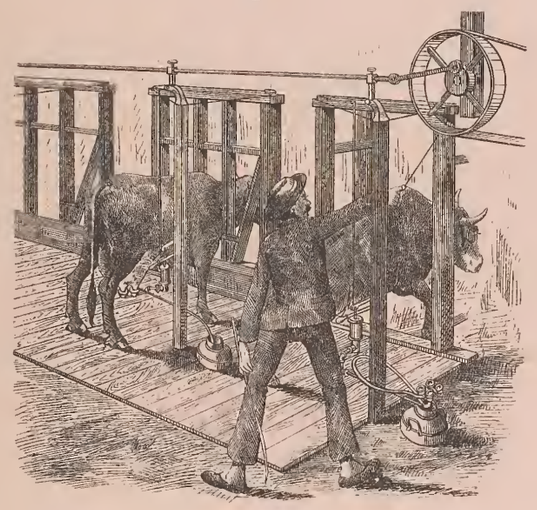
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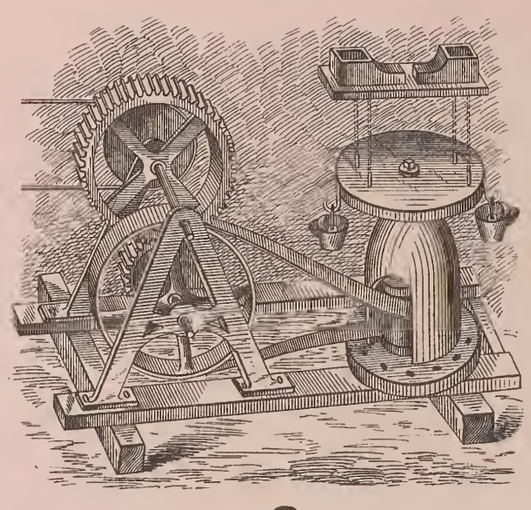
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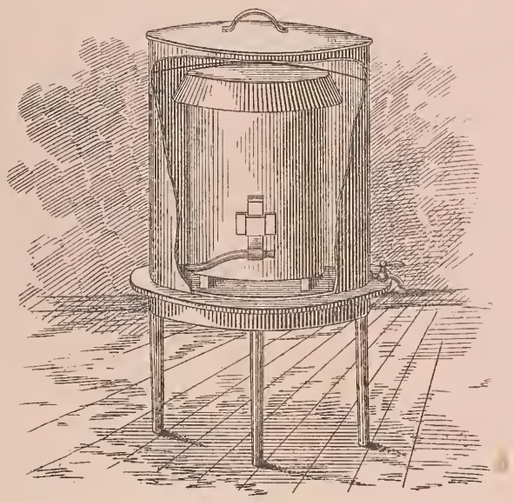
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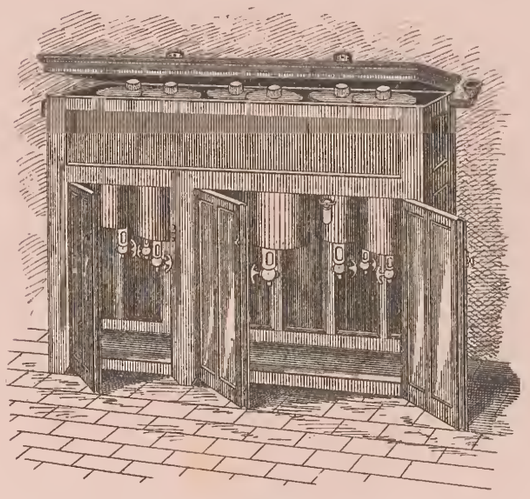
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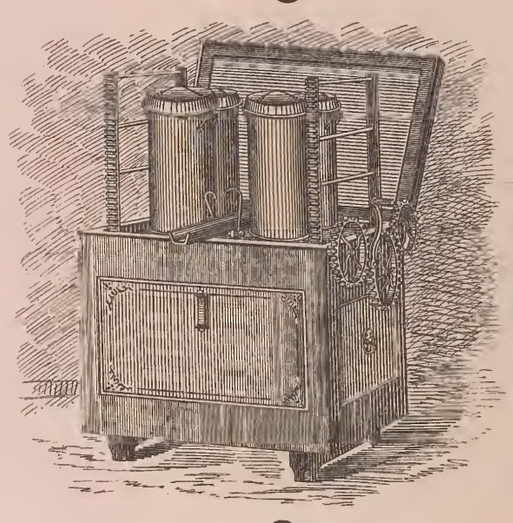
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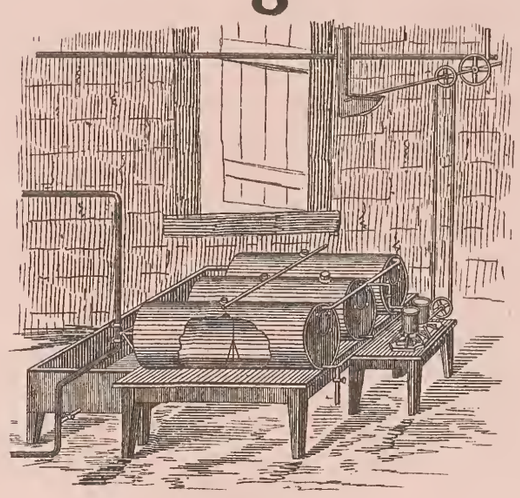
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CREAMERY AND MILK.

CREAMERY AND MILK.

No. 1. Primitive Hand Milker.
2. " Dairy.
3. " Dutch Deep Setting Creamer.
4. U. S. Patent, Vacuum Milker—A. D. 1868.
5. " " Aerating Creamer—A. D. 1872.
6. " " Centrifugal Creamer—A. D. 1872.
7. " " Water Sealed Can—A. D. 1877.
8. " " Cabinet Creamer—A. D. 1879.
9. " " Elevator Creamer—A. D. 1880.
10. " " Centrifugal Creamer—A. D. 1881.
11. " " Vacuum Creamer—A. D. 1883.
12. " " " Milker—A. D. 1883.

The Liban (coagulated milk) of the Arabs was the usual form in which milk was, and is, used in Arabia.

The Turks show their Tartar origin in their preference for sour milk.

The Arabians and Turks have a preparation of curdled milk called "clan" by the former, and "yaourt" by the latter, which they preserve in bags. Fresh yaourt is much used by the Turks, and Europeans soon acquire a taste for it.

In olden times one or more cows were kept for the general use of a village.

Houses for the protection of cows were not in general use until the 13th century.

A writer says that it was the common opinion in the Virginia Colony "that housing and milking cows in winter would kill them."

Fresh milk, in Uruguay, is sold by driving cows from door to door along the streets, and milking them into jars brought out by the customers.

At the works of the Aylesbury Condensed Milk Co. in England, 200 persons are employed, and the milk of 1,200 cows is daily evaporated.

Borden's American process of condensing milk is protected by letters patent.

There are a number of factories for condensing milk about New York City, where it is sold from house to house fresh from the condensing vats. Thousands of gallons of milk are daily prepared to supply the demand in the Army and Navy, and for foreign consumption.

Colvin's Hydraulic Cow Milker combines a cattle stall and compound milking apparatus operated by power; it is said that three machines are sufficient to milk 60 cows in the time it would take six men to milk them by hand.

It requires 15,000,000 cows to supply the demand for milk and its products in the United States.

The value of the butter, cheese, and milk produced in the United States in the single year of 1884 was $500,000,000, and the value of dairy products aggregated something like $100,000,000 more than the entire wheat crop of the country was worth.

CREAMERY AND MILK.

3,932 Cheese and Butter Factories in the United States.

	*1860	1880
Capital Invested,	$8,000.00	$9,604,803.00
Value of Productions,	13,400.00	25,742,510.00
Wages Paid,	984.00	1,546,495.00
Hands Employed,	7	7,903

* Cheese only

FARM DAIRY PRODUCTS.

	1860	1880
Milk sold or sent to factories, galls.,	Not reported.	530,129,755
Butter made, pounds,	459,681,372	777,250,287
Cheese made, pounds,	103,663,927	27,272,489

Capacity—	Primitive Mode.	Present Machine.
Time required to separate Cream and Milk,	24 hrs.	13 mins.
Loss by imperfect separation,	¼	0
Gallons Milk separated per hour,		120

460 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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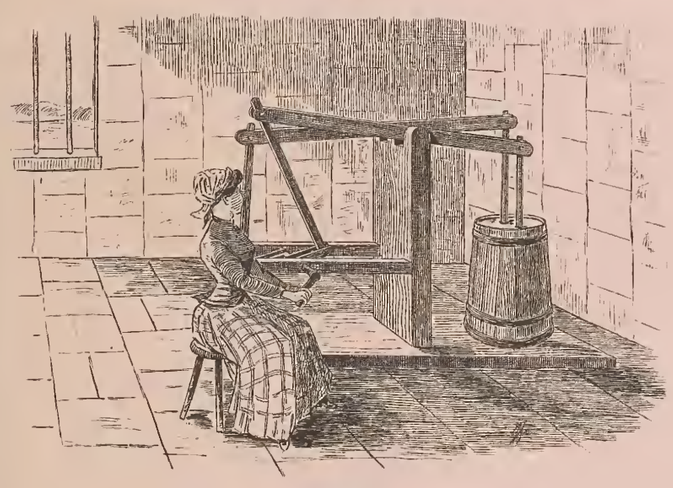
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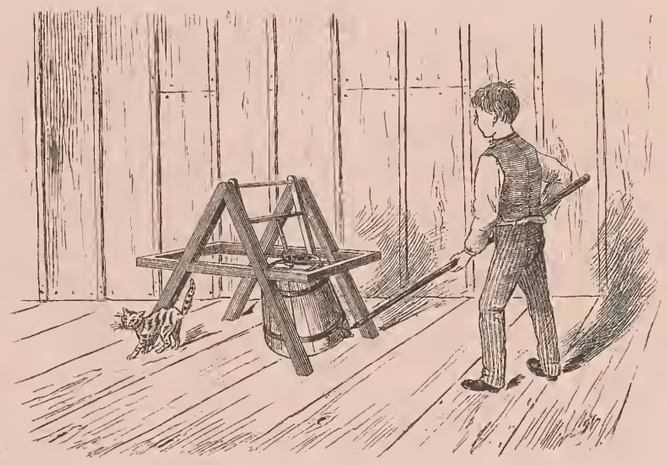
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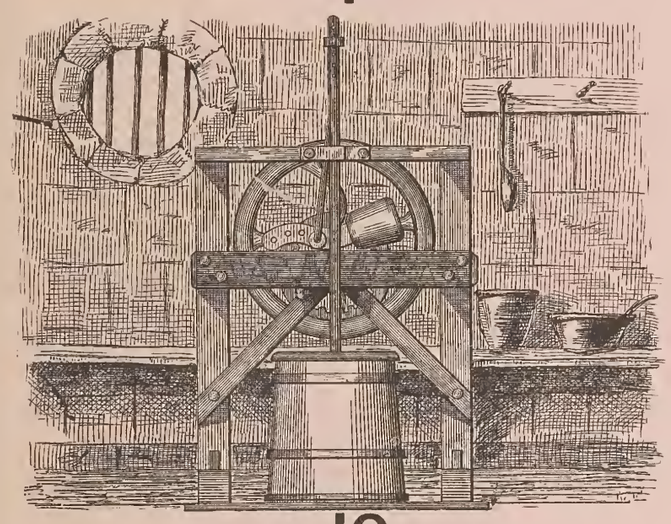
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CHURNS.

CHURNS.

No. 1. Primitive Scythian.
2. " Grecian.
3. Dutch Mode of Operating.
4. Plunger.
5. U. S. Patent, Rotary—A. D. 1807.
6. " " Vibrating—A. D. 1808.
7. " " Working Body—A D. 1835.
8. " " " " —A. D. 1835.
9. " " " " —A. D. 1872.
10. " " Rotary—A. D. 1883.
11. " " Vibrating—A. D. 1884.
12. " " Rotary—A. D. 1884.

The ancient method of making butter was probably the same as that practiced by the Bedouin Arabs and the Moors at the present day, the cream being placed in a goat skin and agitated by hand or treading upon it with the feet.

The butter and honey mentioned by Isaiah vii, 15, is to this day an article of food in the East. The butter and honey are mixed, and the bread dipped therein.

It was butter of kine and milk of sheep that made Jeshurine "wax fat."

Abraham took butter and milk, and the calf which he had dressed, and set them before three stranger visitors.

Sisera asked water, and Jael, the wife of Heber the Kennite, gave him milk. She brought forth butter in a lordly dish before she nailed him to the ground with a tent pin and hammer.

Job refers to the time when he annointed his feet, or, as he expressed it, "washed my steps with butter, and the rock poured me out oil. Surely the churning of milk bringeth forth butter."

The oldest mention of butter is the account given of the Scythians, by Herodotus: "These people pour the milk of their mares into wooden vessels, cause it to be violently stirred or shaken by their blind slaves, and separate the part that rises to the surface, as they consider it more valuable than that which is collected below it."

At the present time, in Uruguay, South America, the dairyman pours the milk, while still warm, into an inflated pig or goat skin, hitches it to his saddle, and gallops five or six miles into town, with the milk sack pounding along on the road behind him. When he reaches his destination his churning is over, the butter is made, and he peddles it from door to door.

Churns are classified in the United States Patent Office as follows: Double acting, reciprocating, multiple dasher, single dasher, combined lever and crank mechanism, foot mechanism, hand and foot mechanism, rocking seat mechanism, diagonal dasher, horizontal single dasher, horizontal double dasher, concentric shafts, parallel shafts, vertical, &c.

The motion which is said to give the best results in churning is that which produces a thud or shock. The swing churn is a small keg or slender barrel, suspended in a horizontal position, for making small quantities of butter. It has been highly recommended. Various wheel churns have been invented.

From 40 to 60 minutes is the recognized time in which to make butter.

The census of 1880 estimated the production of butter in the United States as 806,672,071 pounds annually.

CHURNS.

3,932 Cheese and Butter Factories in the United States.

	*1860	1880
Capital Invested,	$8,000.00	$9,604,803.00
Value of Productions,	13,400.00	25,742,510.00
Wages Paid,	984.00	1,546,495.00
Hands Employed,	7	7,903

* Cheese only.

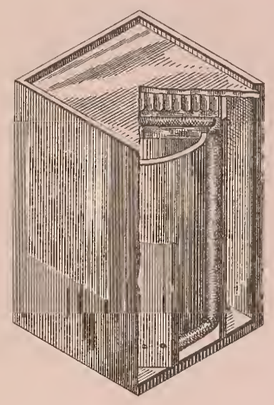
Capacity—	Primitive Mode.	Present Machine.
Pounds Butter per day,	20	1,500
Hands Employed per day,	1	1

1,776 Patents Granted by the United States.

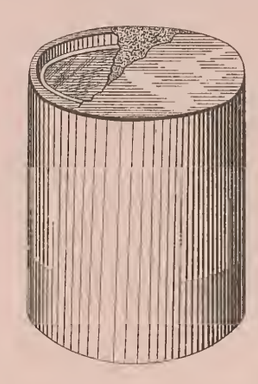
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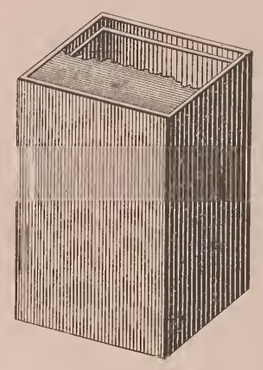
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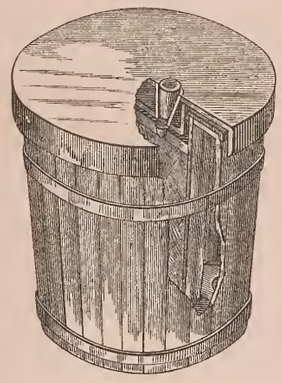
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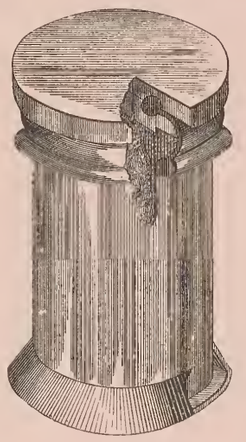
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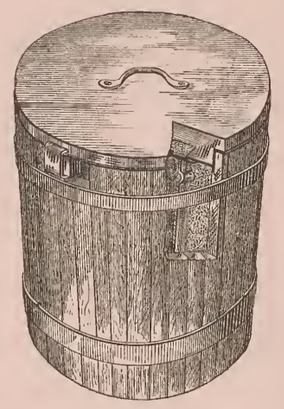
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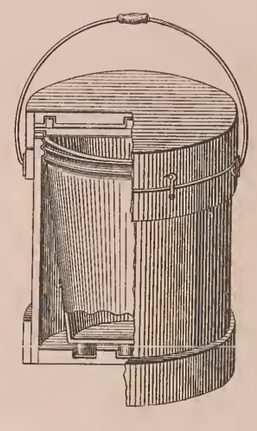
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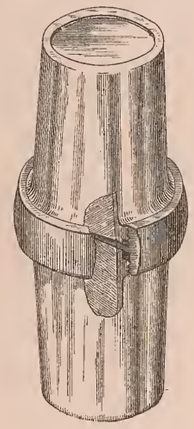
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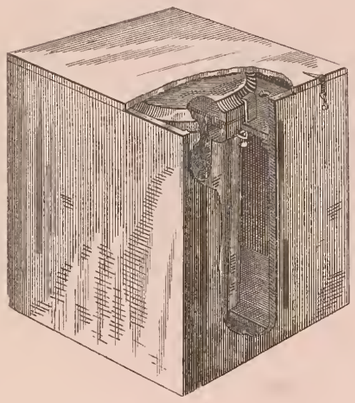
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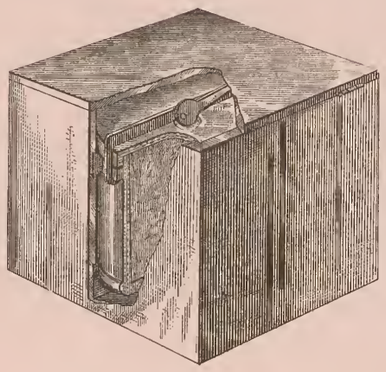
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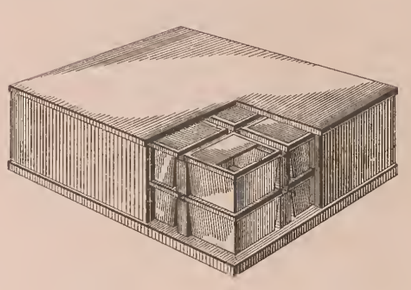
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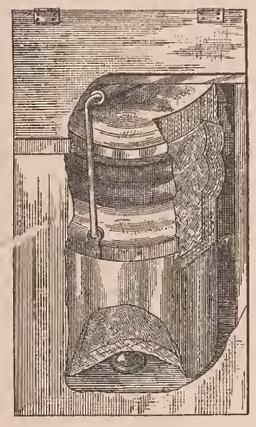
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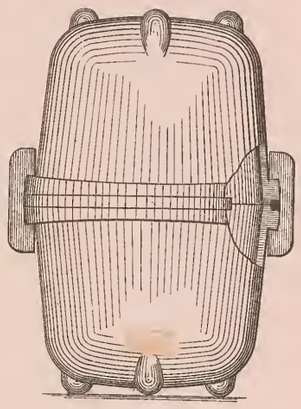
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BUTTER PACKAGES.

BUTTER PACKAGES.

1. U. S. Patent, Butter Package—A. D. 1867.
2. " " Air Chambered Shipping Case—A. D. 1868.
3. " " Butter Jar—A. D. 1869.
4. " " Butter Bucket—A. D. 1870.
5. " " Preserving and Transporting Package—A. D. 1872.
6. " " Cylindrical Package—A. D. 1876.
7. " " Butter Tub—A. D. 1878.
8. " " Transporting Package—A. D. 1878.
9. " " Packing Case—A. D. 1882.
10. " " Transporting Package—A. D. 1883.
11. " " Hermetic Closed—A. D. 1883.
12. " " Glass Crock—A. D. 1883.
13. " " Jar Package—A. D. 1884.
14. " " Air Tight Package—A. D. 1884.
15. " " Sealed Butter Package—A. D. 1884.
16. " " Butter Dish and Package—A. D. 1884.

Butter is of very great antiquity. A name for the substance is found in the writings of the old Hebrew, Greek, and Latin authors. This name greatly resembles in sound our English word "bruter," and is derived from a word which means to "beat" or "strike." The same substance is frequently mentioned in the Bible.

Butter is the fatty substance present in the milk of the mammalia, and capable of being extracted from it.

The Hebrews, in ancient times, used butter largely as an article of food. With this people it is still extensively used, and largely takes the place of lard in their cooking.

The Greeks and Romans used it only as an ointment in their baths. The packages in which it was held for this purpose were dainty boxes, of fine workmanship, some of which were intended for the toilet tables of the belles of ancient Athens and Rome.

It is probable that some of the finely-wrought metal boxes found in the ruins of Pompeii once contained butter, to be used as an ointment somewhat as the ladies of the present day use vaseline.

In Southern Europe it is still sparingly used.

In Italy, Spain, Portugal and Southern France, it is sold by apothecaries as a medicinal agent for external application. When thus used it is put up in small boxes similar to those in which we buy salve or other ointments.

As butter came into more general use it seemed to lose its original meaning of "something beaten," and the name was applied by chemists to any substance of the consistency of butter. It is also applied to certain metallic substances, which have an oily appearance resembling melted butter. Thus we have butter of antimony, bismuth, zinc, and tin.

In this country butter is a very important industry. In the past decade the demand for it became so great that a bogus butter known as oleomargarine was thrown on the market and christened "butter." The law interfered during the Forty-ninth Congress, and protected the butter buyer from the oleomargarine dealer.

Butter, as its original meaning would indicate, is procured from cream by a process of striking or beating, called churning. The milk and water are carefully extracted from the butter thus produced, salt is added, and the article is ready for packing. The most economical and cleanly receptacle for butter is a wooden vessel. Wooden butter tubs of every grade and size are made for this purpose. The large creameries in this country use these tubs almost exclusively.

A very primitive way of packing butter is still in vogue in country houses. This is to pack the butter in stone jars, make them air-tight, and keep them in a cool place.

Another method of packing butter was very common during the middle of this century. It was to press the butter into glass jars, hermetically seal them, and keep in a cool place.

The wooden butter tub is by far the most economical and the most popular, but certain creameries use other receptacles.

A very useful device is in the shape of a square, compact wooden box. This box is intersected with small compartments of wood, just large enough to hold a print of butter weighing one pound or one-half pound.

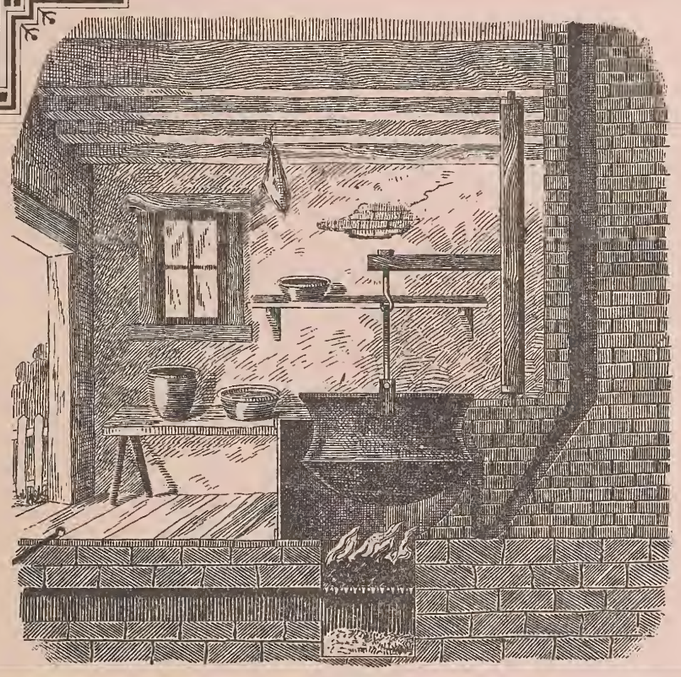
Another useful form of box for transporting butter short distances is a square box with layers of thin wooden slats, on which the half-pound prints are placed after being covered with a small square of cheese cloth to prevent sticking together. When one layer of slats is filled up a second is placed in the box just above the prints. A great many pounds of butter are packed in this way every day for the large markets.

470,000 tons of butter were shipped in the United States in 1884.

BUTTER PACKAGES.

136 Patents Granted by the United States.

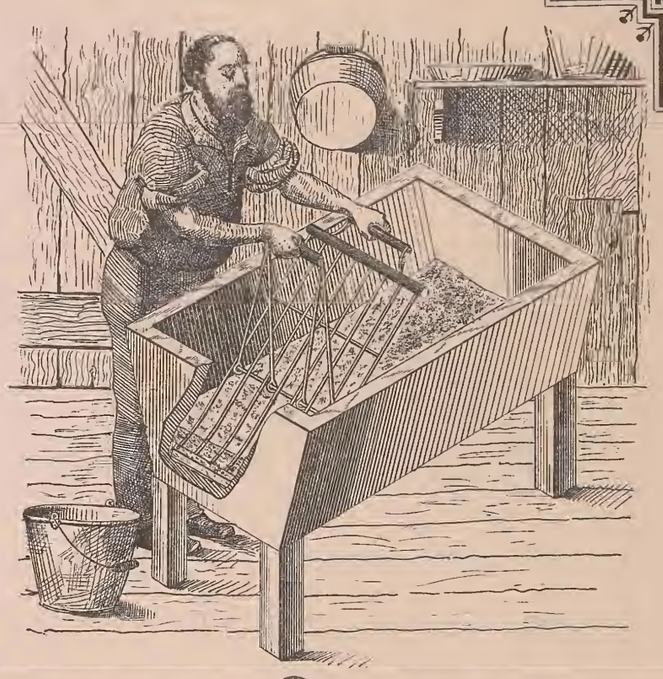
Sackett & Wilhelms Litho Co New York



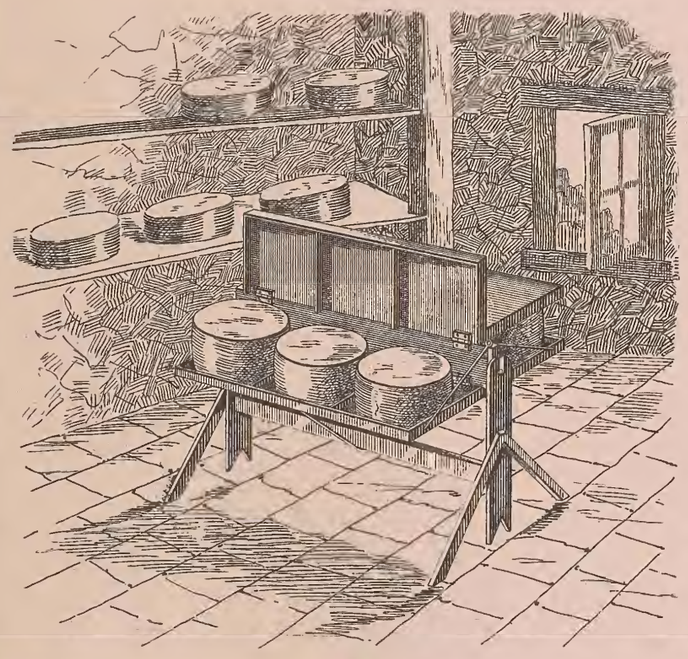
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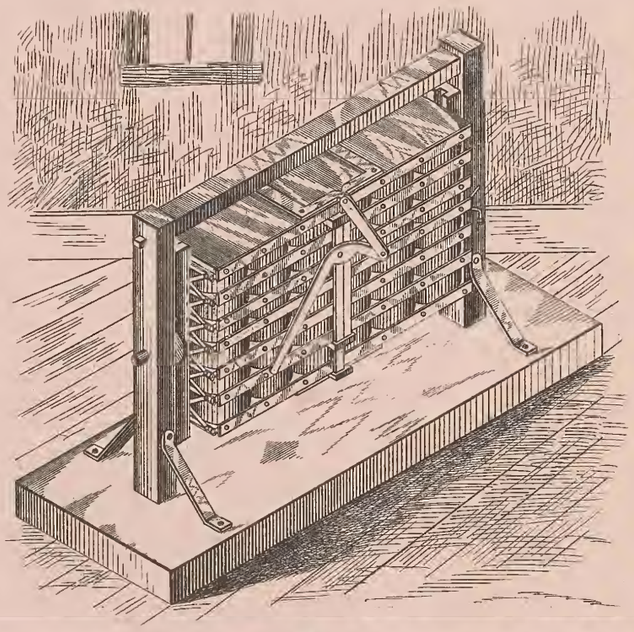
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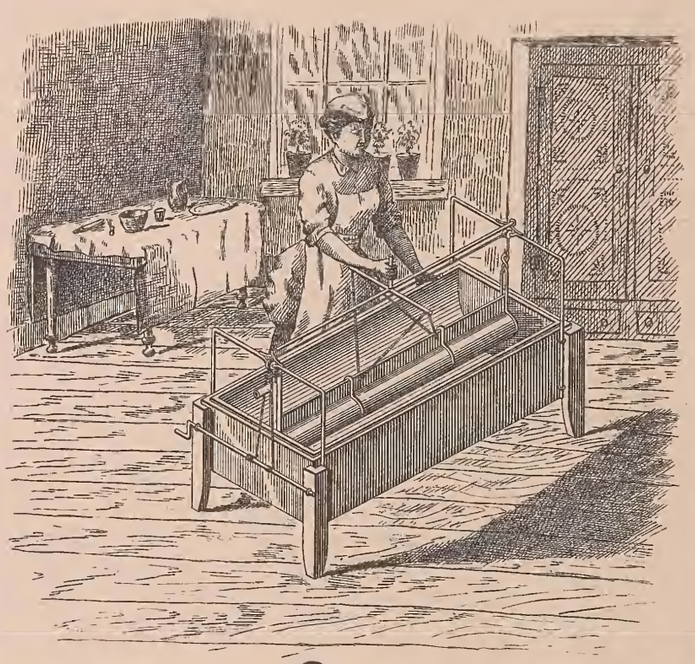
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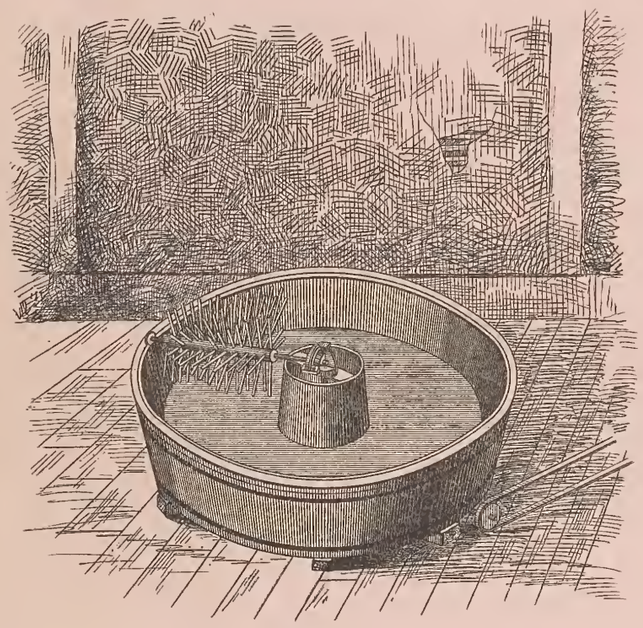
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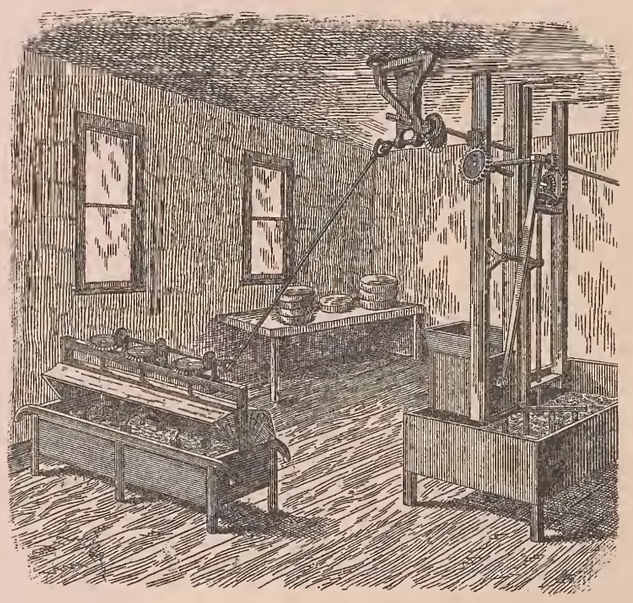
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CHEESE MANUFACTURE

CHEESE MANUFACTURE.

No. 1. Dutch Vat.
2. " Curing.
3. U. S. Patent, Curd Agitator—A. D. 1863.
4. " " Curing—A. D. 1868.
5. " " Frame—A. D. 1871.
6. " " Vat—A. D. 1880.
7. " " Automatic Stirrer—A. D. 1881.
8. " " " " —A. D. 1884.

Hippocrates, 460 B. C., said the mode of preparing cheese from milk was discovered by the Scythians. It was an article of food among the pastoral nations of Canaan and Asia Minor.

Virgil says cheese was the common diet of the Roman shepherds.

Cheese is mentioned three times in the Old Testament, but each time under a different Hebrew name.

Burckstadt says cheese was coagulated dried buttermilk, ground and eaten by the Arabs.

Jesse sent cheese by the hands of David to the captain of the thousand which the brethren of the latter served, (1 Samuel, xv, 11–18,) and cheese of kine was brought to David.

Job complains in his anguish "Hast thou not poured me out as milk, and curdled me like cheese?"

The sizes of cheeses vary in different places. Where the manufacture is carried on upon a large scale, as in Cheshire, England, the cheeses weigh from one hundred to two hundred pounds each. From twenty to sixty pounds are common sizes.

Some of the most famous varieties are the Parmesen, made in the richest part of the Milanese Territory, Gruyere, a Swiss variety, the Cheshire, Stilton, and Suffolk of England, and the Neufchatal of France.

Cheese is made of the milk of goats and sheep as well as from that of cows.

The Chinese prepare cheese from peas and beans.

In Saxony cheese is made from potatoes.

The imports of cheese into the United States are estimated at 2,000,000 pounds, and the exports at 110,000 pounds annually.

There were manufactured in 1880, in the United States, 243,157,850 pounds of cheese.

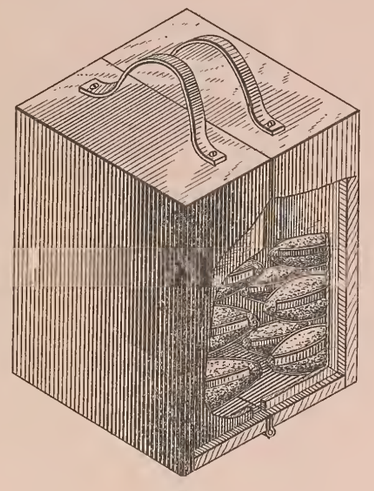
CHEESE MANUFACTURE.

3932 Manufactories in the United States.

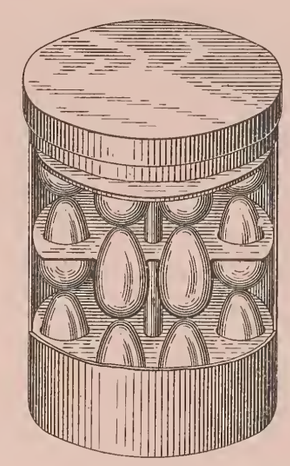
	1860	1880
Capital Invested,	$3,000.00	$9,804,803.00
Value of Productions,	13,400.00	25,742,510.00
Wages Paid,	984.00	1,548,495.00
Hands Employed,	7	7,903
		1880 Pounds.
Cheese made in factories,		215,885,361
" " on farms,		27,272,489
Total,		243,157,850

259 Patents Granted by the United States.

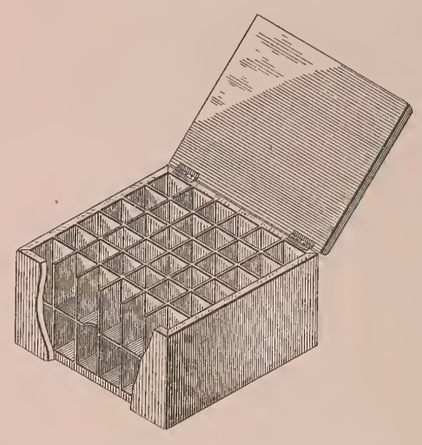
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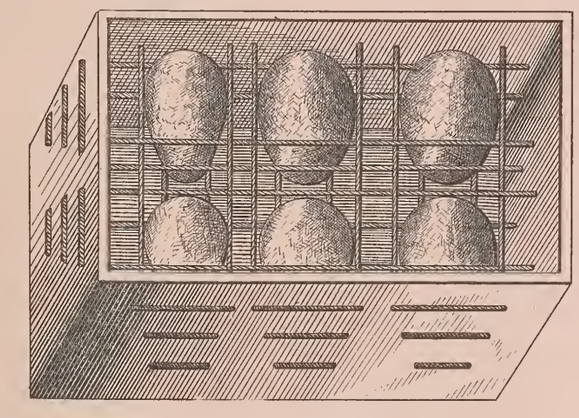
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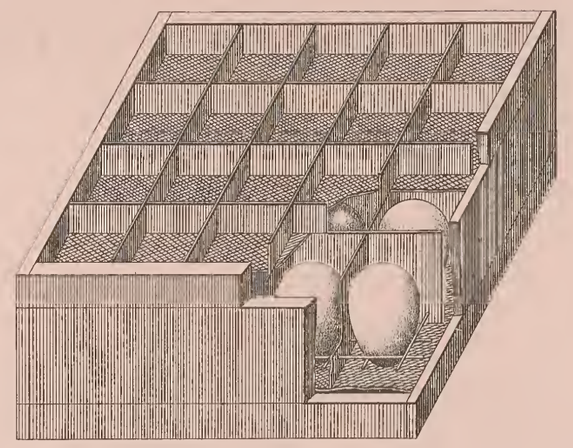
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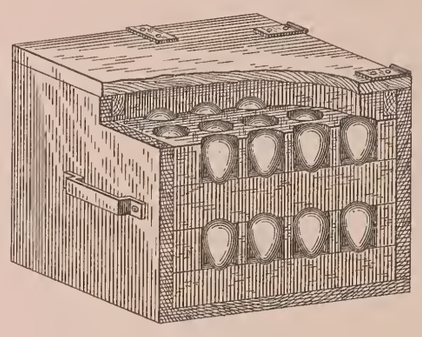
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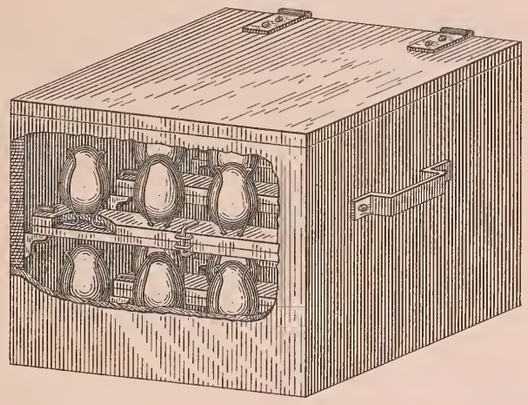
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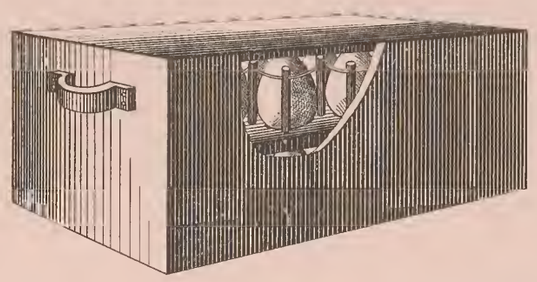
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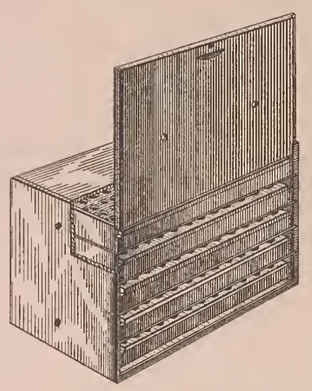
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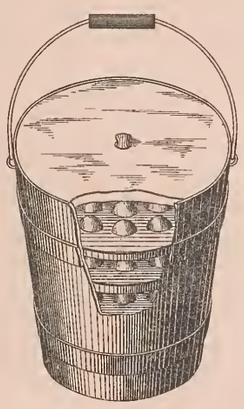
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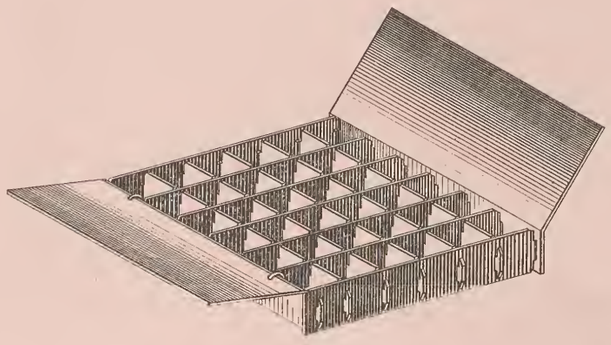
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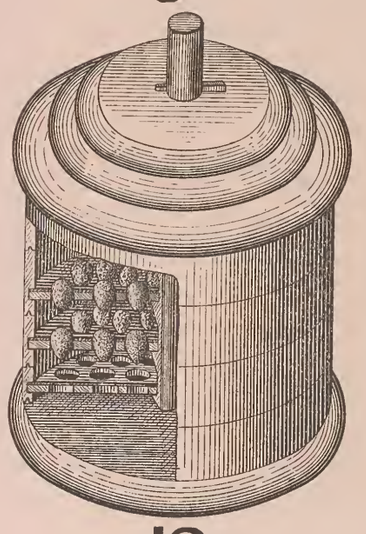
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12

EGG CARRIERS.

EGG CARRIERS.

1. U. S. Patent, Egg Holder—A. D. 1855.
2. " " " Packer—A. D. 1865.
3. " " " Transporting Case—A. D. 1867.
4. " " " Carrier—A. D. 1868.
5. " " " " —A. D. 1869.
6. " " " " —A. D. 1871.
7. " " " " —A. D. 1872.
8. " " " " —A. D. 1876.
9. " " " " Box—A. D. 1878.
10. " " " " Pail—A. D. 1882.
11. " " " " —A. D 1883.
12. " " " " —A. D. 1884.

The largest eggs of which we have any account were found in 1850, in Madagascar. They belonged to a bird which has become extinct. Two of these eggs are preserved in the French Academy; one of them measures 13¼ inches in its largest diameter and 8¼ in the shortest; the shell is about one-eighth of an inch thick; the capacity of the egg is about 8¼ quarts. The size of the boxes necessary to carry this size of eggs could hardly be considered.

The immense increase in the hens' egg industry of late years has made a convenient method of transporting them a necessity. In 1880 the number of eggs reported was 456,910,916 dozens. This number has been steadily increased.

Many devices have been patented for the convenience of the consumer and the tradesman. One of these is the egg assorter, by which eggs are assorted according to quality, being so placed that a strong light is brought to bear upon them when stuck into holes in a board. Their comparative translucency is then observed, and is accepted as an evidence of quality.

Another apparatus, known as the egg detector, was invented for the same purpose. In this the eggs are placed upright in the holes in the lid of a dark chamber, and their transmitted light is observed upon a mirror. Their quality is determined by their translucency, as evinced by the relative transmission of light. An egg becomes opaque and cloudy as it becomes spoiled.

A simple appliance for holding eggs is a pair of tongs, not unlike sugar tongs, into which the wider part of an ordinary egg usually fits. There are two designs of an egg glass; one is for holding the egg while eating it, the other is a sand glass, which runs three minutes, the proper time for boiling an egg to render it more digestible.

Egg packers, transporting cases and carriers are in many varieties of shape, size and material. The most useful case for packing is a wooden box, divided into squares just large enough to hold one egg. These squares are made of thin brown pasteboard, and are packed in layers until the box is full.

In one invention frames are supplied with cloth pockets for carrying the eggs. This, however, is too expensive to be used on a large scale.

A primitive method, but one still practiced at the present time, is to pack eggs in a box with sawdust or salt, strewn in so as to prevent contact.

EGG CARRIERS.

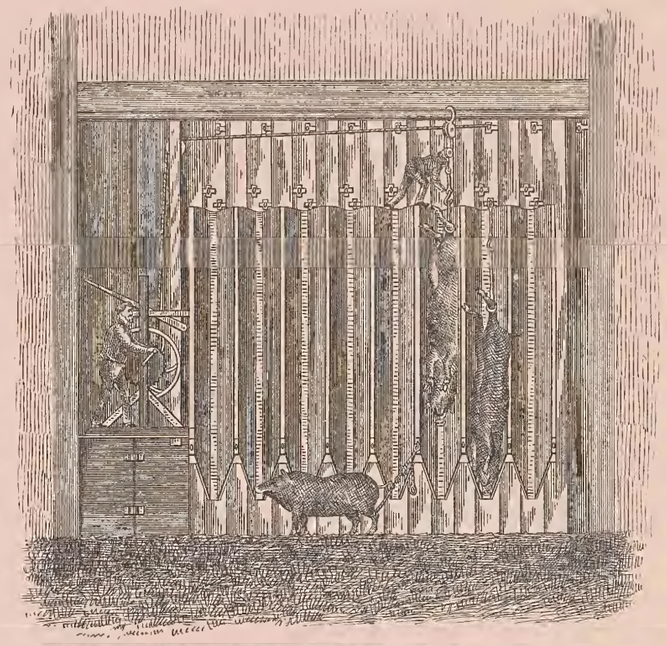
Eggs Produced in 1879, doz., - - 456,910,916

238 Patents Granted by the United States.

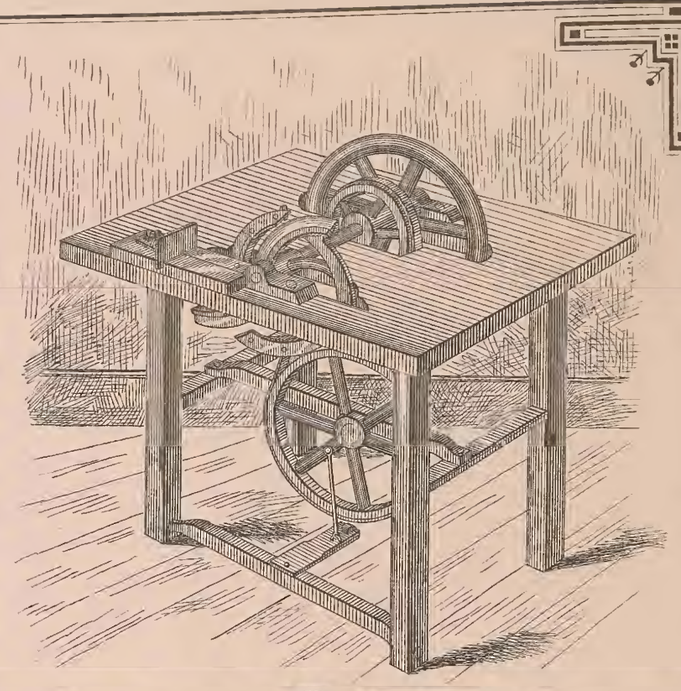
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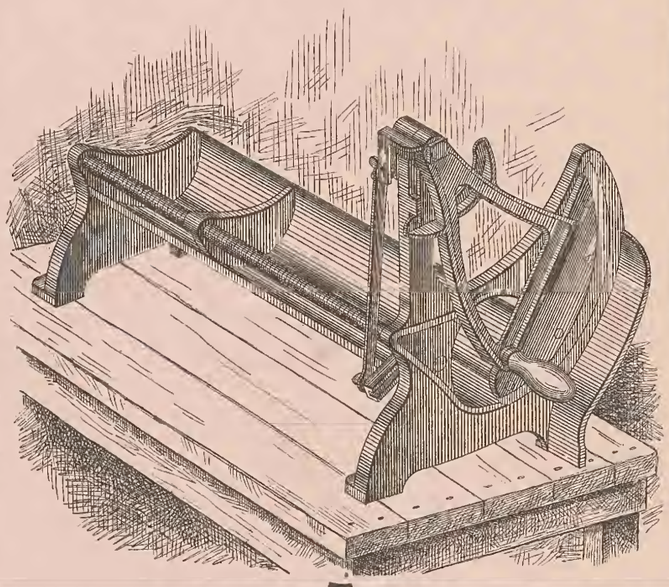
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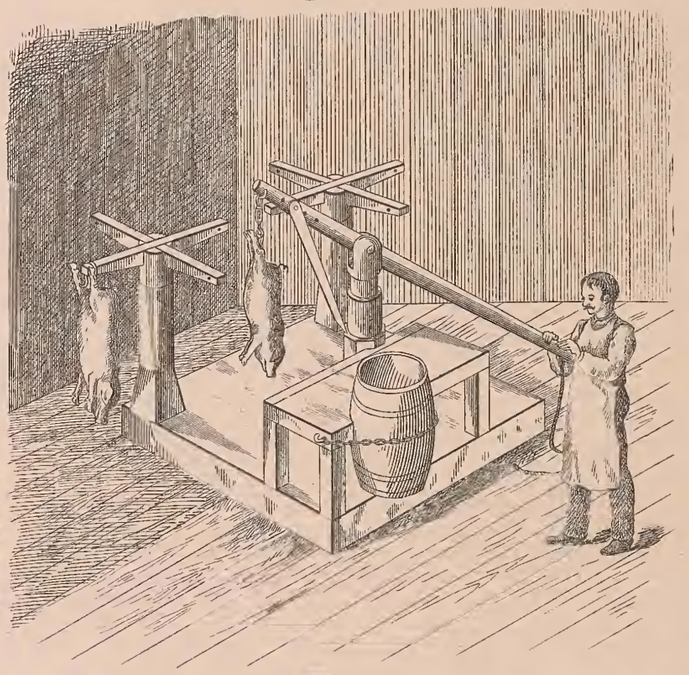
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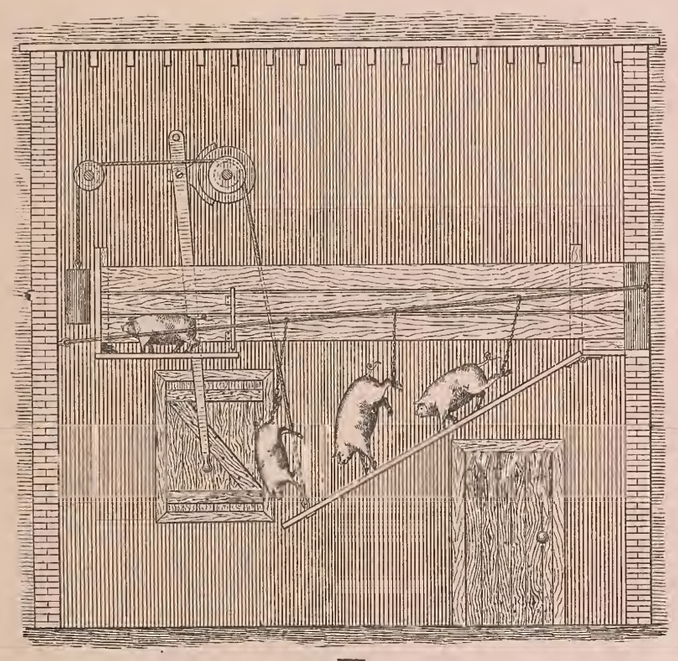
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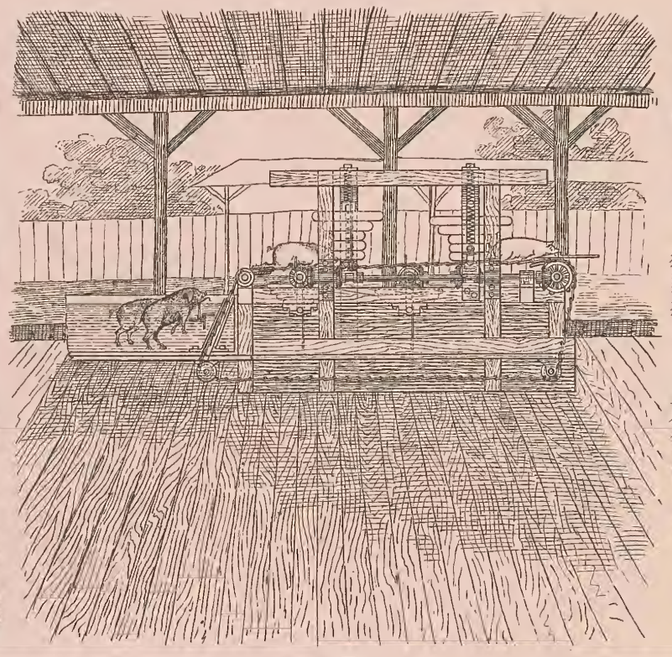
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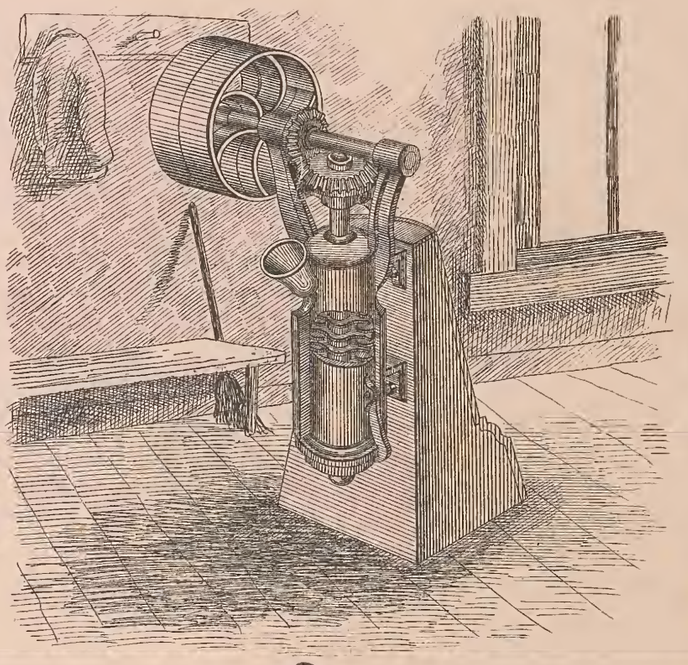
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SLAUGHTERING AND MEAT CUTTING.

SLAUGHTERING AND MEAT CUTTING.

No. 1. Primitive Scalding.
2. English, Catching and Suspending—A. D. 1808.
3. U. S. Patent, Meat Chopper—A D. 1874.
4. " " Catching and Suspending—A. D. 1881.
5. " " Meat Slicer—A. D. 1881.
6. " " Scalding—A. D. 1882.
7. " " Catching and Suspending—A. D. 1882.
8. " " Scalding and Scraping—A. D. 1882.
9. " " Cutting and Mincing—A. D. 1883.

In the sculptures at Thebes butchers are represented sharpening their knives on a round bar of metal, which is suspended from their girdles or from the hem of the apron. This was evidently a steel.

The daily provision of meat for King Solomon's household was ten fat oxen and twenty oxen from the pasture.

The Romans established regular colleges, or companies, composed of a certain number of citizens, whose office was to furnish the city with the necessary cattle, and to superintend the butchers in preparing and vending the meat.

Nero built a noble market for the sale of butchers' meat.

Butchers' sheds, for the sale of meat, were first erected at Dunstable, England, in 1279.

In the middle ages the right of a common slaughter house, where the inhabitants might have their beasts killed, was a feudal privilege.

The old plan of making sausage was to cut the meat by means of cleavers, one in each hand. In early times, in the West, sausage was cut on the block by an axe. This was much slower than the handy little pair of cleavers, which were kept for the purpose and went the round of a settlement when hog butchering began.

The earlier forms of sausage machines used cleavers, which were at first on levers tripped by cam movement from the main shaft.

Afterward knives were made to reciprocate vertically by means of crank and shaft. The tub usually rotates beneath the knives so as to bring the meat in succession beneath the cutters. A scraper lifts the meat and turns it over so that the knives shall not repeat the blow in the same place.

The favorite domestic form of sausage cutter is a compact little machine. It is either a spiral row of steels, projecting radially from a barrel and forcing the meat between knives projecting inwardly from the casing; or, it has a series of radial knives on each of a pair of cylinders, placed so as to make a shear cut against each other; or the single barrel has knives which cut against opposed edges inside the case.

In each case the spiral vane forces the meat through the machine, which is cut as it passes along, and is discharged at the end opposite that at which it was fed.

Slaughtering apparatus for beeves usually consists of a mode of hauling the animal up to the place where it is stunned by a pole axe, and then bled. Also of a hoisting tackle, by which it is lifted while the skin and viscera are removed, and then swung clear of the floor to be washed and left to cool.

The slaughter of cattle in the United States per year is estimated at 8,500,000 head, and of hogs at 4,500,000.

One of the great industries connected with the supply of food, viz., slaughtering and meat packing, yields an aggregate product of 303,562,413 pounds per year in the United States.

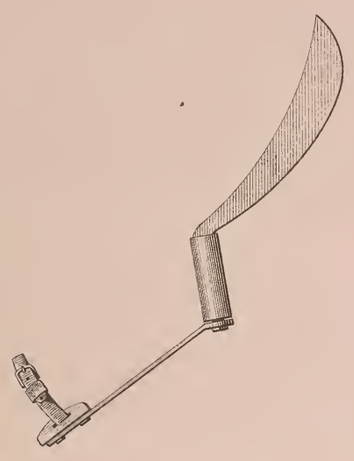
SLAUGHTERING AND MEAT CUTTING.

872 Slaughtering and Meat Packing Establishments in the United States.

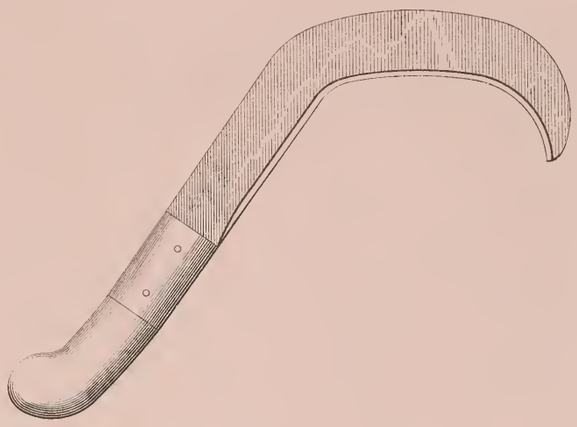
	1870	1880
Capital Invested,	$22,124,787.00	$49,419,213.00
Value of Productions,	62,140,439.00	303,562,413.00
Wages Paid,	2,007,101.00	10,508,530.00
Hands Employed,	6,485	27,297

401 Patents Granted by the United States.

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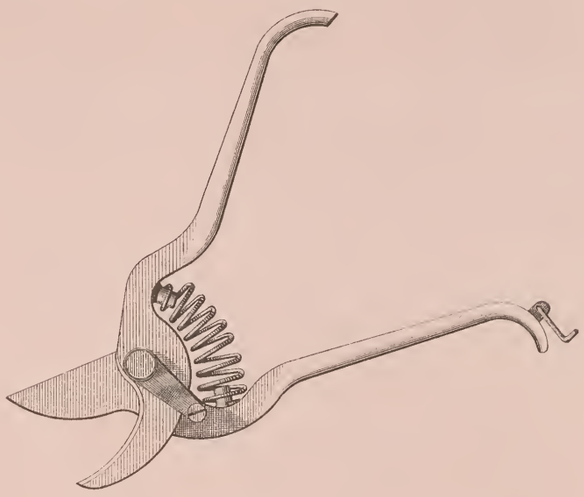
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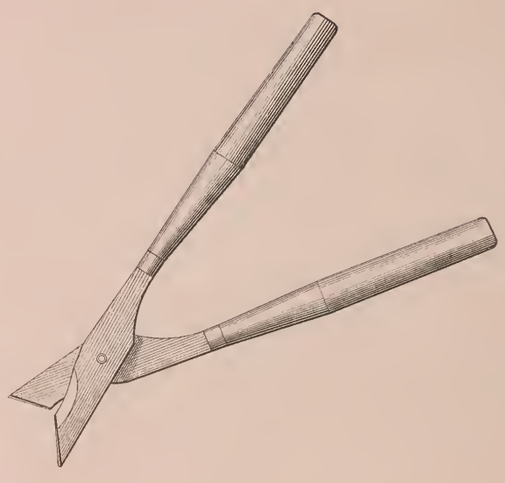
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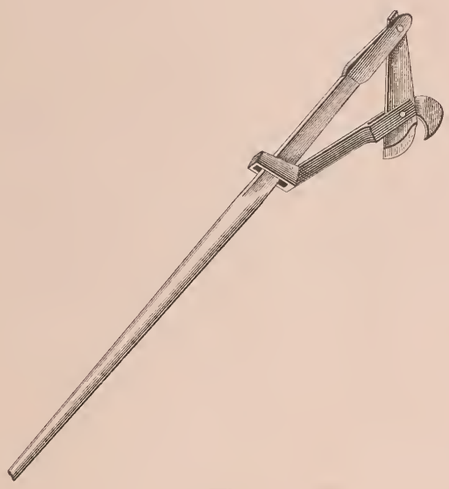
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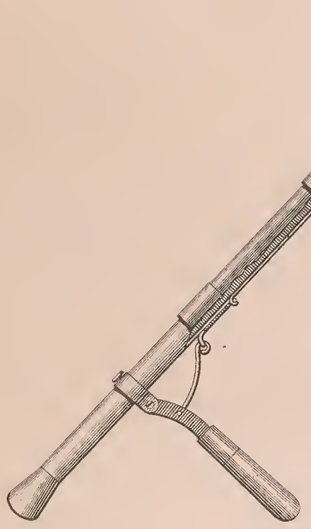
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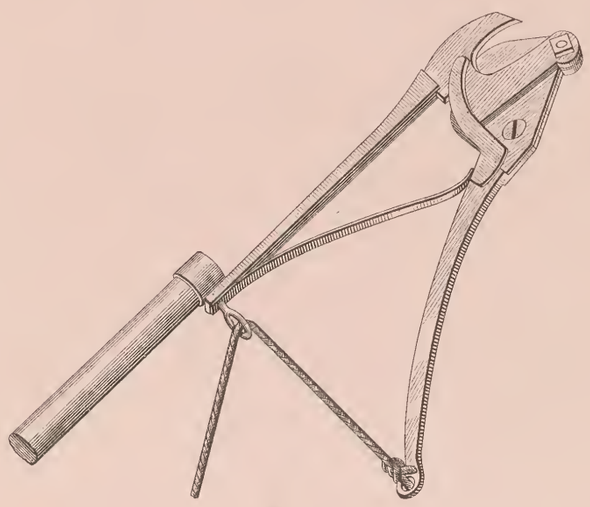
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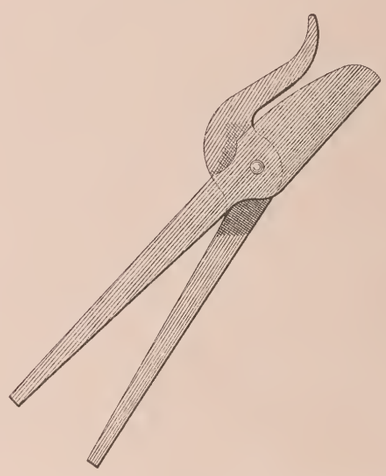
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12

PRUNING IMPLEMENTS.

PRUNING IMPLEMENTS.

1. U. S. Patent, Pruning Implement—A. D. 1859.
2. " " Pruning Hook—A. D. 1863.
3. " " Pruning Knife and Staff—A. D. 1866.
4. " " Pruning Shears—A. D. 1869.
5. " " Pruning Shears—A. D. 1871.
6. " " Tobacco Plant Cutter—A. D. 1873.
7. " " Pruning Knife—A. D. 1874.
8. " " Pruning Hook—A. D. 1877.
9. " " Hooked Blade Pruning Implement—A. D. 1879.
10. " " Pruning Hook—A. D. 1881.
11. " " Pruning Shears—A. D. 1882.
12. " " Tobacco Plant Cutter—A. D. 1884.

Reference is made to pruning in the Scriptures. In each instance where the pruning hook is mentioned it refers to its conversion into a spear or from a spear. It was a much heavier tool than the pruning knife, and cut by a blow, like a bill or machete.

Pruning implements of the present day are, principally, the pruning chisel, pruning hook, pruning knife, saw, mallet, bill hook, shears.

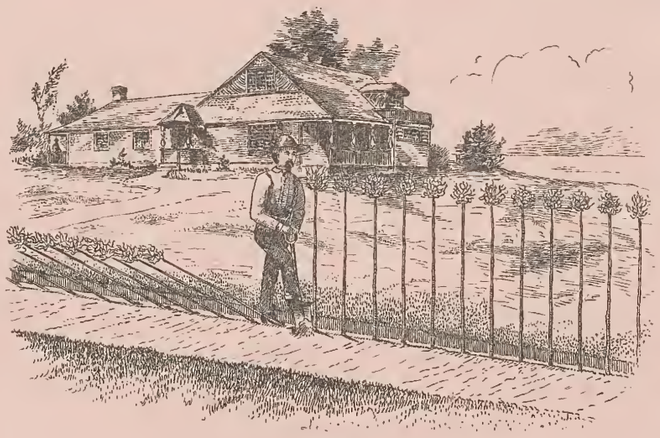
PRUNING IMPLEMENTS.

205 Patents Granted by the United States.

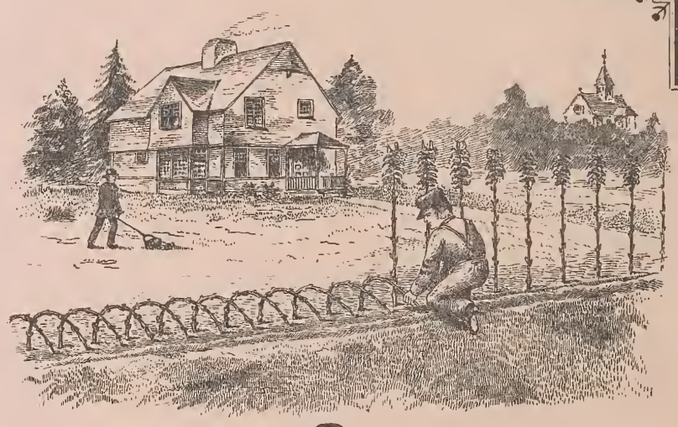
Sackett & Wilhelms Litho Co New York



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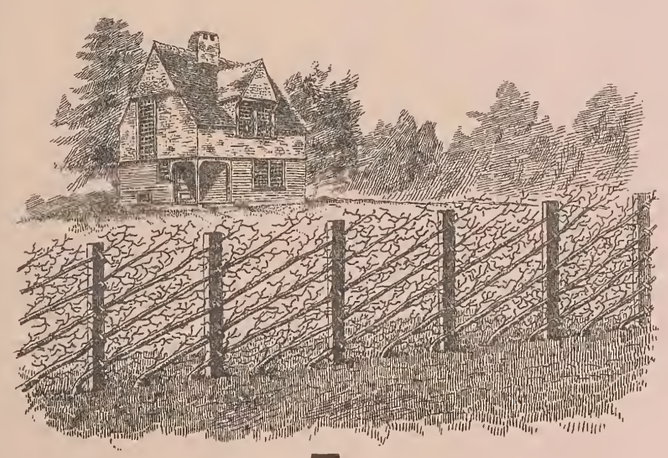
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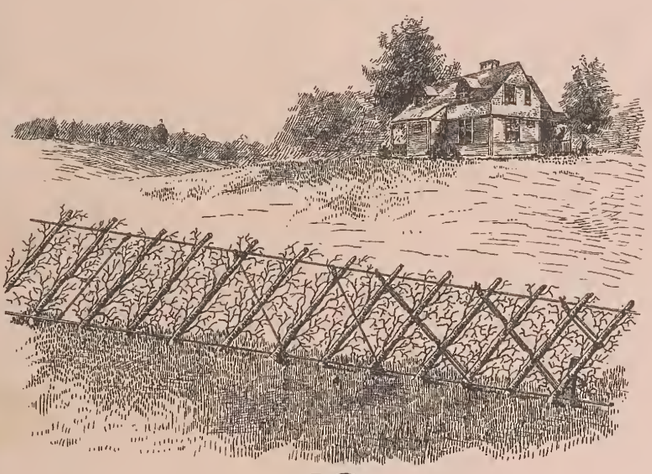
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HEDGE TRAINING.

HEDGE TRAINING.

1. U. S. Patent, Hedge Bender—A. D. 1867.
2. " " Hedge Fence—A. D. 1869.
3. " " Hedge Fence—A. D. 1870.
4. " " Plashed Fence—A. D. 1876.
5. " " Hedge Bender—A. D. 1878.
6. " " Constructing Osage Orange Hedge—A. D. 1878.
7. " " Plashed Fence—A. D. 1878.
8. " " Hedge Fence—A. D. 1881.
9. " " Cactus Hedge Fence—A. D. 1882.
10. " " Plashed Hedge—A. D. 1882.
11. " " Plashed Hedge Fastening—A. D. 1882.
12. " " Plashed Fence—A. D. 1883.

The thorn hedge is mentioned in the bible. It is the ordinary fence of to-day in Palestine.

Thorns for hedges were used by the Grecks, 1000 B. C.

Homer represents Ulysses as finding Lærtes digging and preparing to plant a row of quick sets.

Pliny says the art of clipping trees was invented by Martius, a friend of the Emperor Augustine.

In some of the fruit counties of England hedges are made of pear trees trimmed to the proper height. Hazel is also much used by the English. The buckthorn and hawthorn are common; the latter is more used than any other hedge shrub. In the United States some varieties of thorn are used, but the osage orange is in most general use. Ornamental hedges in this country are made of spruce, arbor vitæ, and rose. Portugal laurel, bay, and other evergreens are also used in England.

Hedges are planted in single and double rows.

The osage orange has a tendency to run up rapidly; it is planted in a single row, six inches apart; 10,560 plants will set a mile of hedge.

Cactus is becoming a favorite for hedges in Texas and the West. It grows extensively from the upper waters of the Arkansas and Platte Rivers far into Mexico. It flowers in May and June, growing from six to fifteen feet in height.

Hedging tools are thus enumerated: Scuffle hoe, hedging spade, shears, bill hook.

The plashed fence, a kind of hedge, is extensively used in the prairie regions of the West where timber is scarce.

HEDGE TRAINING.

35 Patents Granted by the United States

Sackett & Wilhelms Litho Co New York



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ADVERTISING DEVICES.

ADVERTISING DEVICES.

No. 1. U. S. Patent, Changeable Door Plate—A. D. 1844.
2. " " R. R. Time Indicator—A. D. 1860.
3. " " Wagon—A. D. 1868.
4. " " Barber's—A. D. 1872.
5. " " Clock—A. D. 1876.
6. " " Tobacconist—A. D. 1877.
7. " " Revolving—A. D. 1878.
8. " " Reflective—A. D. 1882.
9. " " Luminous Door Plate—A. D. 1884.

The ancient Greeks made their public announcements by writing. The Romans also largely advertised private and public matters by writing as well as by word of mouth; they had criers who, in addition to their other public duties, announced the times and the places of sales of goods, and cried things lost.

Street advertising in its most original form was derived from the Romans.

The first advertisement in newspapers appeared not more than 200 years ago.

Advertising seems to have become general among the French towards the close of the 16th century.

The first known newspaper advertisement, something like the present form, appeared in 1652, in the "Mercurius Politicus," an English publication.

The earliest articles advertised were books.

Advertising had become general in the year 1700.

The first advertising agency in the United States was established in 1828.

In 1865 a single number of the "London Times" contained 2,575 advertisements.

The largest advertising publishing house in the United States employs 40 persons and has files of 6,000 periodicals.

In 1867 Government taxes were collected on nearly $10,000,000 worth of advertisements.

ADVERTISING DEVICES.

1,227 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



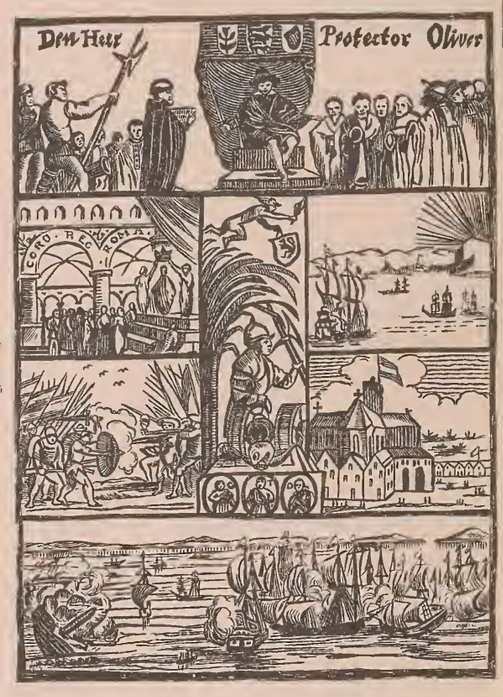
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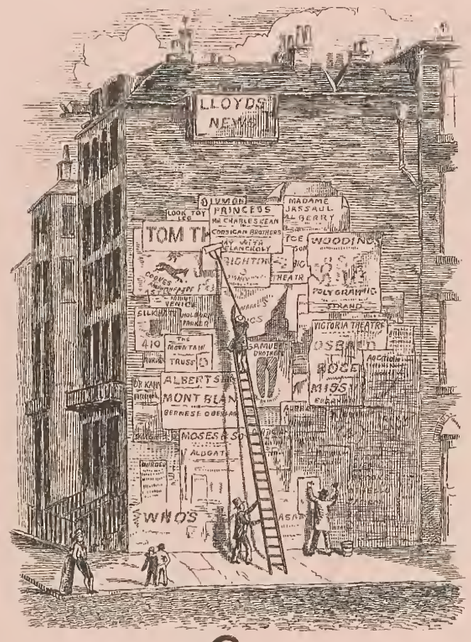
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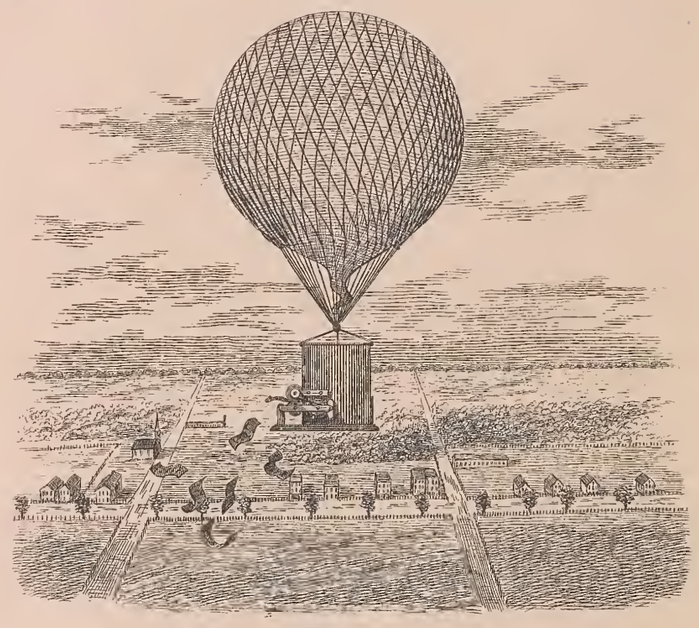
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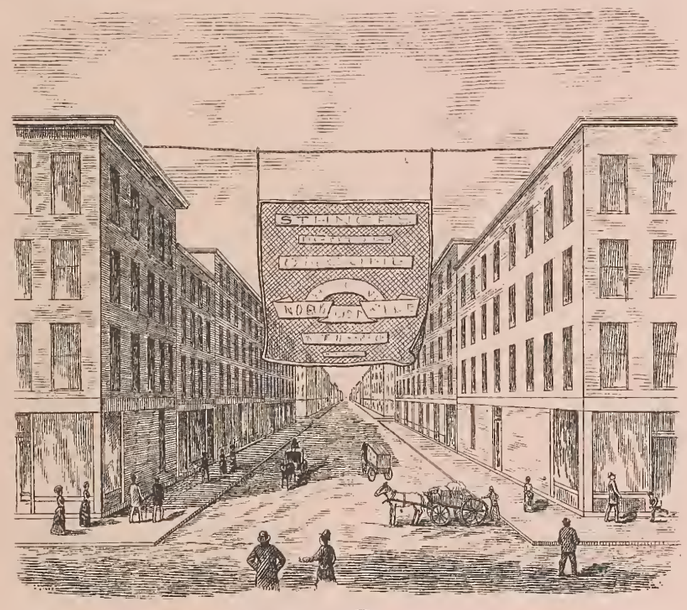
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ADVERTISING METHODS.

ADVERTISING METHODS.

No. 1. Chinese—B. C. 3000.
2. Egyptian Papyrus—B. C. 2000.
3. English, Bell Man—A. D. 1600.
4. " Periodical—A. D. 1688.
5. " Tombstone—A. D. 1800.
6. " Wall—A. D. 1830.
7. U. S. Patent, Balloon—A. D. 1863.
8. " " Banner—A. D. 1868.
9. " " Electric Reflector—A. D. 1884.

Advertisements, in some form, have existed from time immemorial.

Signs over shops seem to have been the first effort in this line.

The signs of Herculaneum and Pompeii appear to have been made of stone or terra cotta relievo, and set into the pilasters or the sides of the open shop fronts. Thus there have been found a goat, the sign of a dairy, and a mule driving a mill, the sign of a baker, etc.

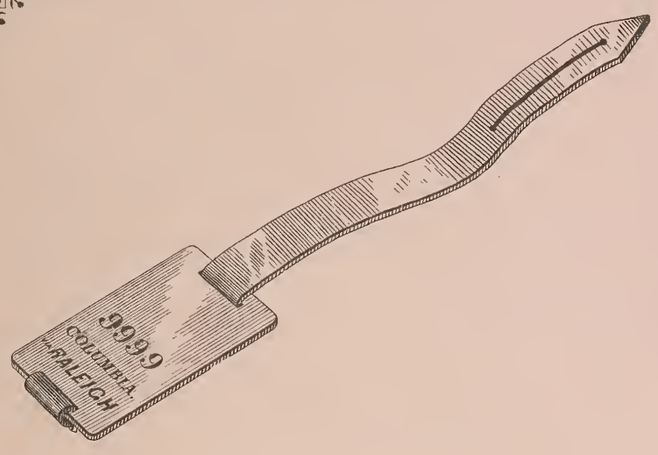
In the middle ages, the houses of the nobility, when the family was absent, were used as hostelries for travelers. The family arms always hung in front of the house, and the most conspicuous object in those arms gave a name to the establishment amongst travelers, who, being unacquainted with the mysteries of heraldry, called a lion gules or azure by the vernacular name of the "Red or Blue Lion." From this source the inn keepers adopted the hanging out of red lions and green dragons as the best way to acquaint the public that they offered food and shelter. The tradesmen used typical objects, as a knife for the cutler, a hand for the glover, and a pair of scissors for the tailor, etc. Every shop had its peculiar sign suspended in the street, and thus, by obstructing the free circulation of the air, it is said to have been one of the causes of the frequent epidemical disorders in London.

All kinds of devices are in use at the present time for advertising purposes, such as automatic smoking and other figures, miniature balloons, revolving show stands, reflecting signs, clocks, picture exhibitors, cigar lighters, umbrellas, casters, hats, pincushions, mirrors, wagons, show cards and card racks.

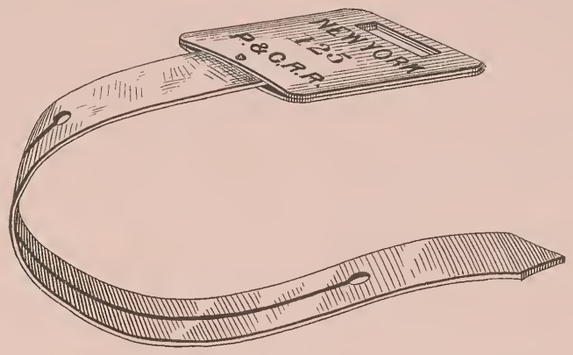
ADVERTISING METHODS.

1,227 Patents Granted by the United States.

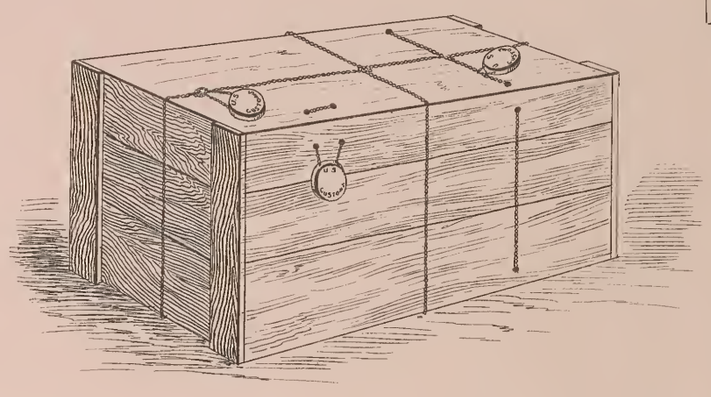
Sackett & Wilhelms Litho Co New York



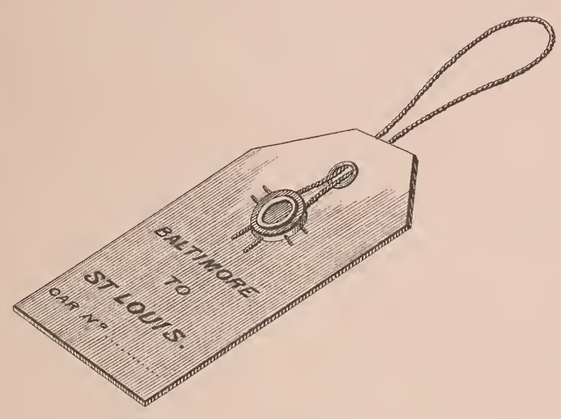
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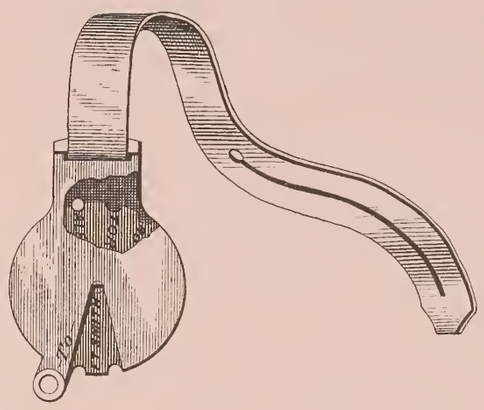
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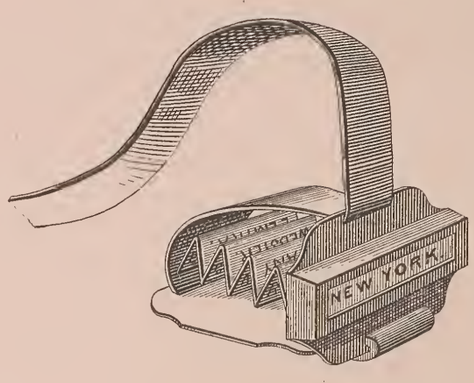
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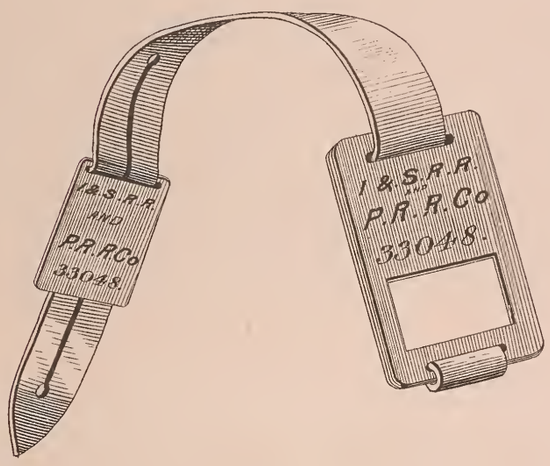
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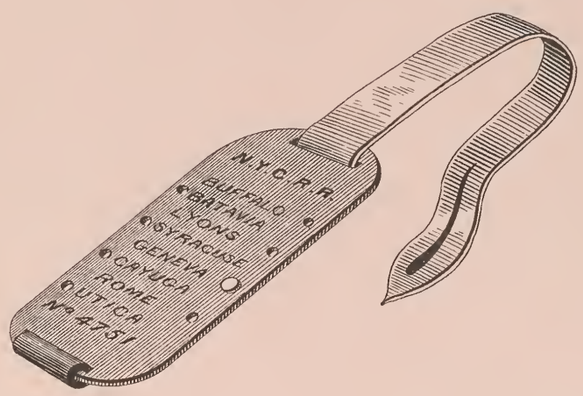
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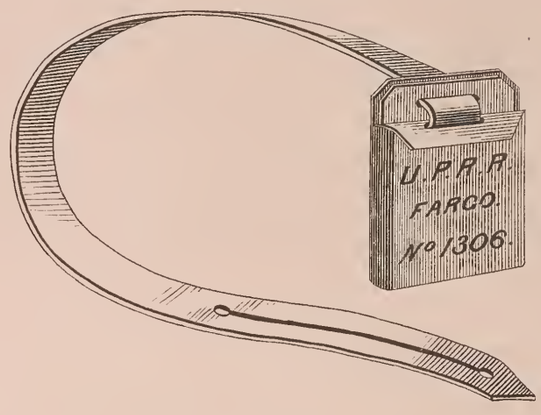
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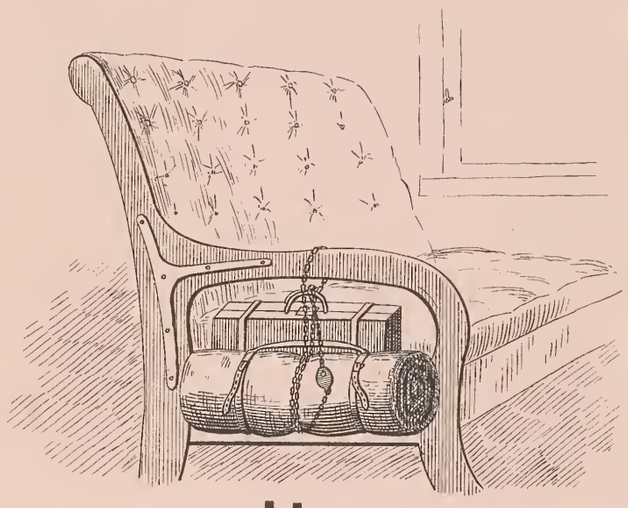
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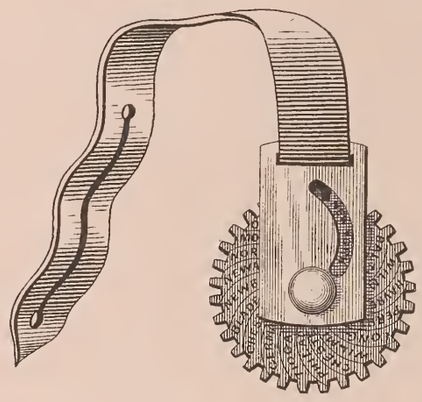
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BAGGAGE CHECKS AND SEALS.

BAGGAGE CHECKS AND SEALS.

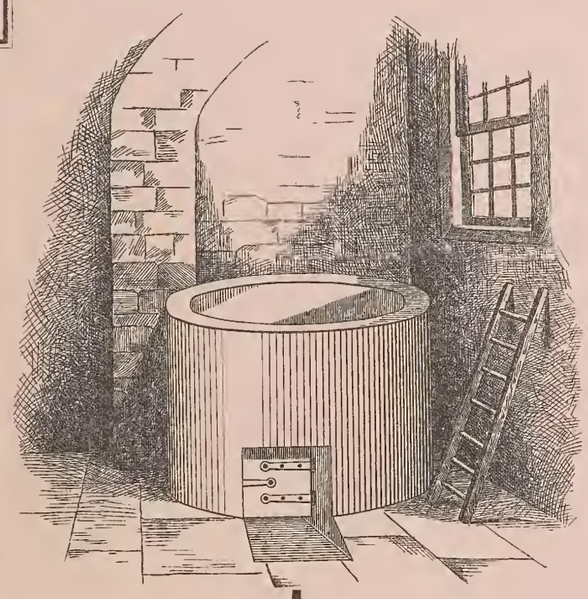
No. 1. Baggage Check—A. D. 1858.
2. " " —A. D. 1865.
3. " Seal—A. D. 1869.
4. Metallic Baggage Seal—A. D. 1875.
5. Baggage Check—A. D. 1877.
6. " " —A. D. 1878.
7. " " —A. D. 1880.
8. " " —A. D. 1882.
9. " " —A. D. 1882.
10. Metallic Seal—A. D. 1883.
11. Baggage Guard—A. D. 1884.
12. " Check—A. D. 1884.

Baggage Checks and Seals are of modern invention; they consist of tags or labels made of metal to be attached to trunks, boxes, cars, etc., to indicate their destination and points of departure, and the name of railway or steamboat company, or stage line attaching the check.

BAGGAGE CHECKS AND SEALS.

117 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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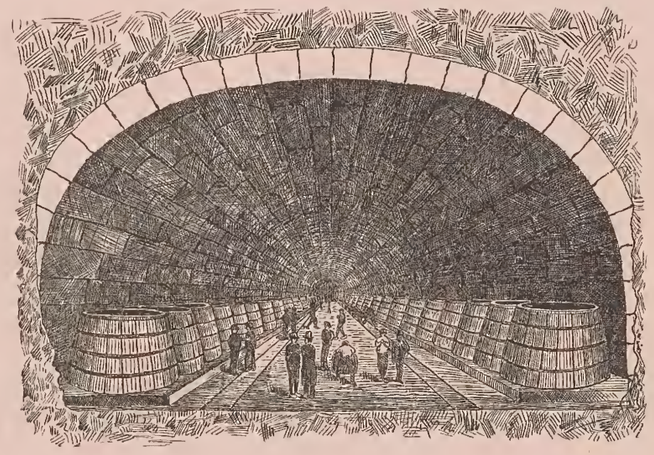
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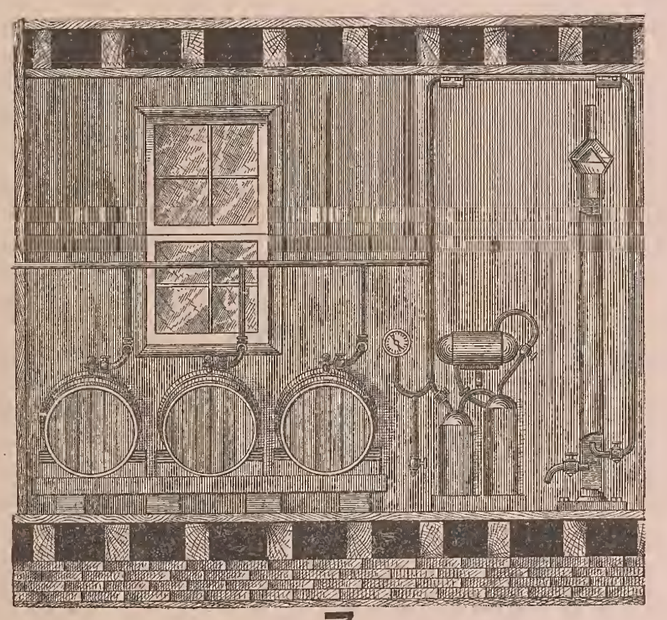
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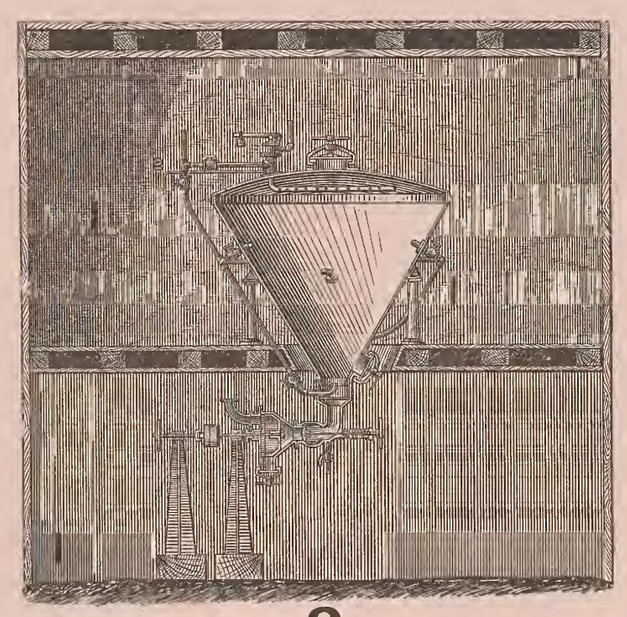
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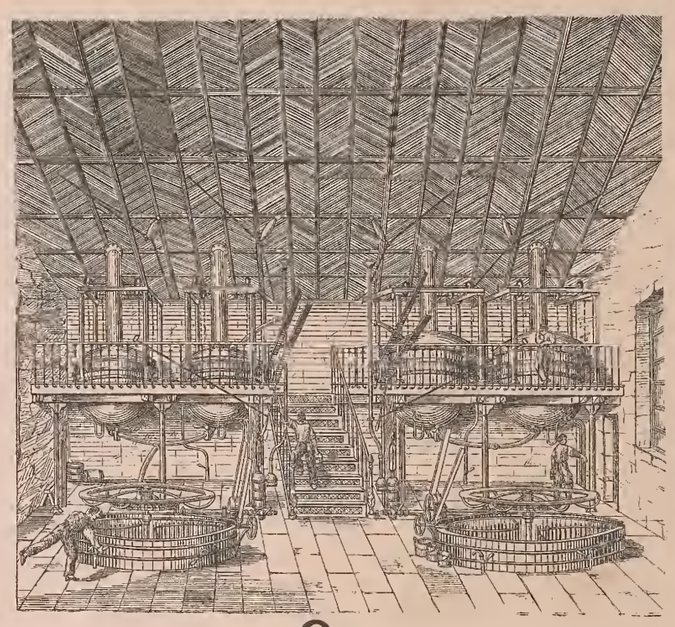
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BREWING.

BREWING.

No. 1. Primitive English Boiler.
2. Early Mash Tub.
3. " Cooler.
4. " Fermenting Tub.
5. Modern Fermenting Room.
6. " Storage Cellar.
7. U. S. Patent, Fermenting Apparatus—A. D. 1883.
8. " " Mash Boiler—A. D. 1884.
9. " " Boiler and Mash Tun—A. D. 1884.

Herodotus wrote, four hundred and fifty years before the Christian era, that "the Egyptians prepared a beer from barley not much inferior to wine."

Ale and ale houses are mentioned in the laws of Ina, King of the Saxons, A. D. 728.

According to an ancient Saxon dialogue, wine was with them the drink of the "elders and the wise," while the common people drank "ale if they had it, water if they had it not."

Ale and beer were first made without hops, which were not raised in England until 1524. English beer was reputed to be the best in Europe. It was brewed in March, and, by persons of consequence, was not used until a year old.

The Laureate Warton, in his ode to Oxford ale, in 1748, laments the declining popularity of a beverage which he is not alone in representing to be the salvation of the British nation.

Among the outfits to New England, in 1629, in addition to four hundred weight of hops, were forty-five tuns of beer to go in the Talbot, provided she had one hundred passengers and eighty-five mariners.

At the time of the settlement of America, tea, coffee and chocolate were almost unknown in England, their places being supplied by fermented liquors.

The earliest mention of a brew house in the colonies is that of Capt. Sedgwick, in Boston, about 1637.

The price at which the best quality of beer was sold in New England, in 1667, was 1½d. per quart.

Pale ale and porter were first made in the United States about 1774.

Seventy-five years ago, brewing, both public and private, was in a very rude state.

In 1870 there were 2,862 breweries in the United States, and 2,671 in England.

The amount of liquor brewed in the United States, in 1871, was estimated at 7,159,440 barrels.

Bavaria stands foremost of all countries in the production of beer.

The consumption of grain and hops by the breweries of the United States, for the year 1883, is estimated at $50,000,000.

Beer brewing in the United States is no longer a trade, but has become one of the great industries of the country. The foreign demand for American malt liquors is rapidly increasing.

It is estimated that nine and one-half gallons of beer are consumed per capita of the population of the United States.

BREWING.

2,191 Manufactories of Malt Liquors in the United States.

	1860	1880
Capital Invested,	$15,782,342.00	$91,208,224.00
Value of Productions,	21,310,933.00	101,058,385.00
Wages Paid,	2,305,970.00	12,198,053.00
Hands Employed,	6,433	26,220

325 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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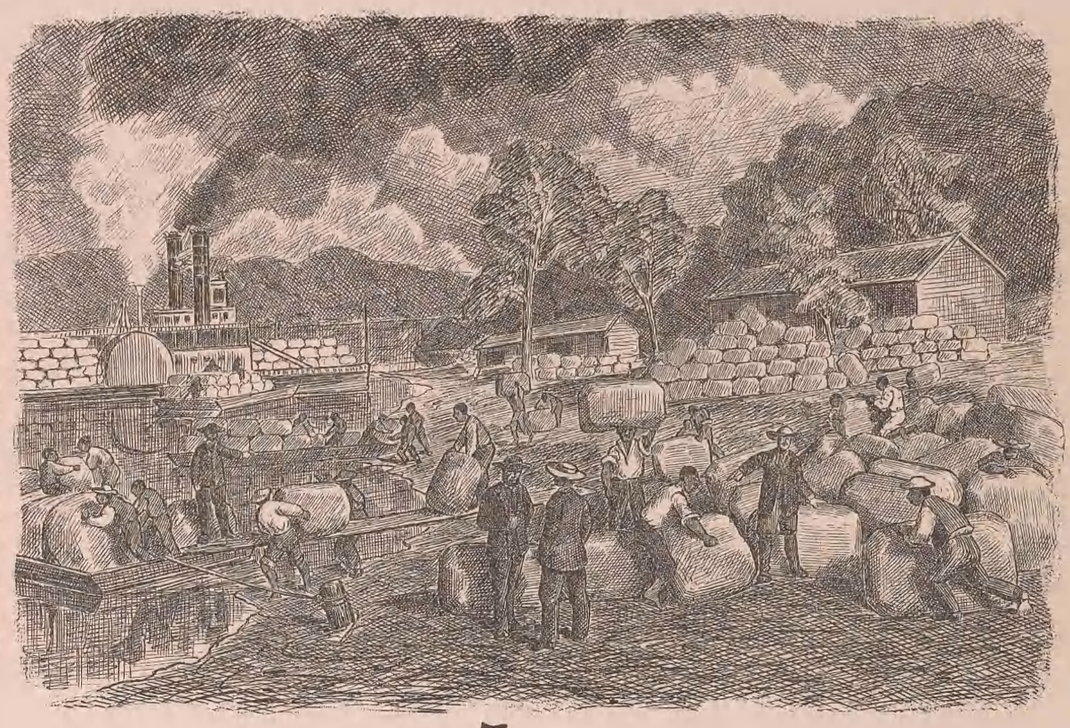
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COTTON--HAND CULTURE AND TREATMENT.

COTTON—HAND CULTURE AND TREATMENT.

No. 1. Planting.

2. Hoeing.

3. Gathering.

4. Packing.

5. Shipping.

The name "Cotton" is derived from the Arabic *Koton.*

The plant is found growing in both the New and Old Worlds.

The earliest notice of cotton is by Herodotus, 450 B. C., who speaks of the trees of India bearing fleeces more delicate and beautiful than sheep, and of the Indians using them for making cloth.

Though the Chinese consume immense quantities, its use and cultivation do not appear to have been known previous to the 11th century, and their own crop still falls short of supplying their wants.

In the New World the manufacture and cultivation of cotton appear to have been well understood by the Mexicans and Peruvians before the discovery of these countries by Europeans.

Cortes gathered it in abundance at Trinidad, and used it to quilt the jackets of his soldiers.

Columbus found the plant growing wild in Hispaniola.

Cotton seed was first planted in the United States in 1621, though its culture was unimportant till after the Revolution.

The first Sea Island Cotton was raised on the coast of Georgia, U. S., in 1786, and the first successful crop at Hilton Head, South Carolina, in 1789.

The use of cotton seed oil for food was introduced in the year 1799.

In 1821 the culture of cotton was commenced in Egypt.

In the early part of the present century the export of cotton from Brazil exceeded that of any country except the United States.

Japan produces a coarse fibered cotton.

Hindoostan produces large quantities.

Burmah also produces a considerable amount.

The soil of Africa is well adapted for its cultivation.

The growth and manufacture of cotton commenced in the United States about 1800.

The first cotton factory in Virginia was erected in 1827, at Petersburg.

The cotton States proper are Texas, Louisiana, Arkansas, Mississippi, Alabama, Georgia, Florida, South Carolina, and a portion of North Carolina and the western section of Tennessee.

It was a theory long held that only slave labor could produce cotton, and it was generally believed that all, or nearly all, of the cotton produced before the War was the result of negro labor. This was not true, as an examination shows that even during the existence of slavery more than one-half the cotton of the country was made by the labor of white men.

In the year 1880 there were 14,480,019 acres of cotton under cultivation in the United States and 5,755,359 bales were raised.

COTTON—HAND CULTURE AND TREATMENT.

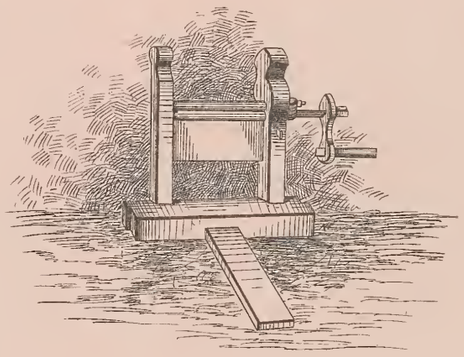
	1860	1880
Area in acres cultivated,	Not reported.	14,480,019
Bales raised,	5,387,052	5,755,359

29 Patents Granted by the United States.

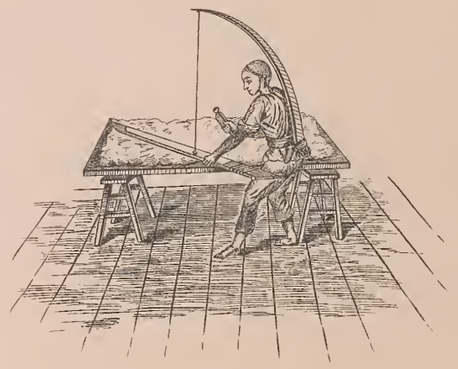
Sackett & Wilhelms Litho Co New York



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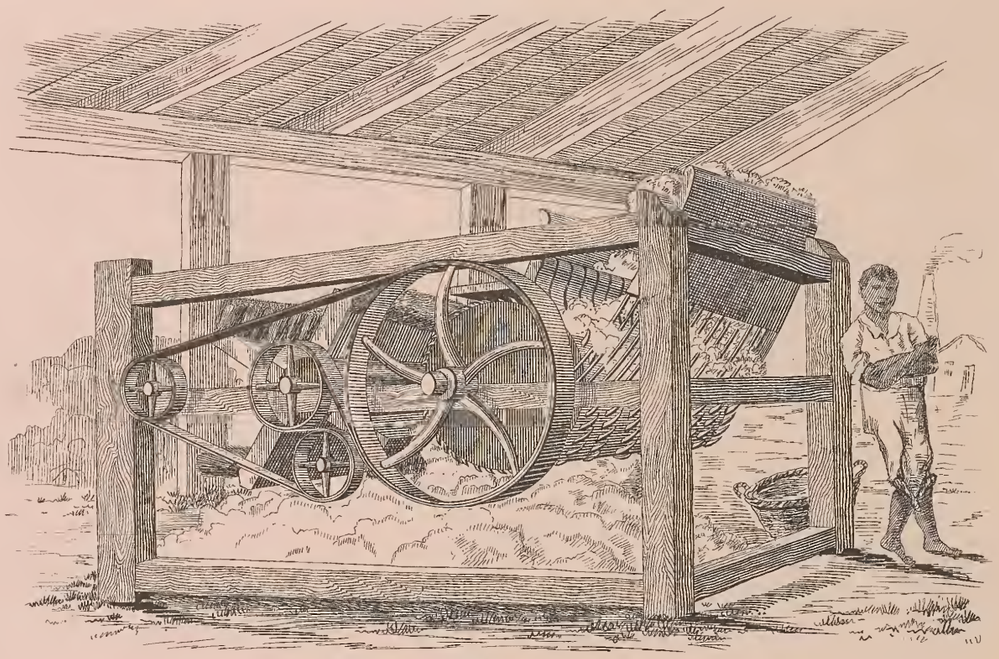
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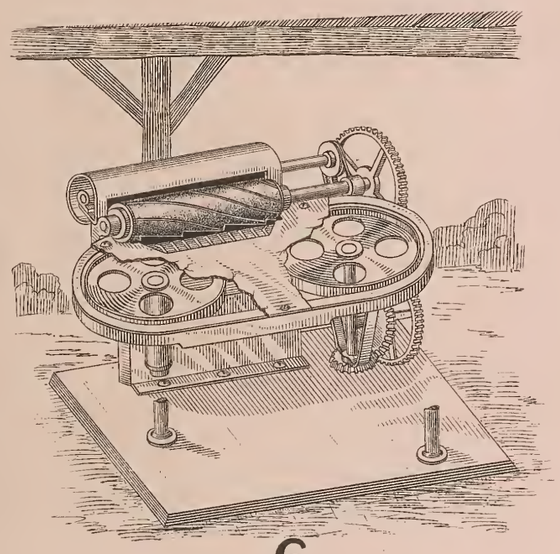
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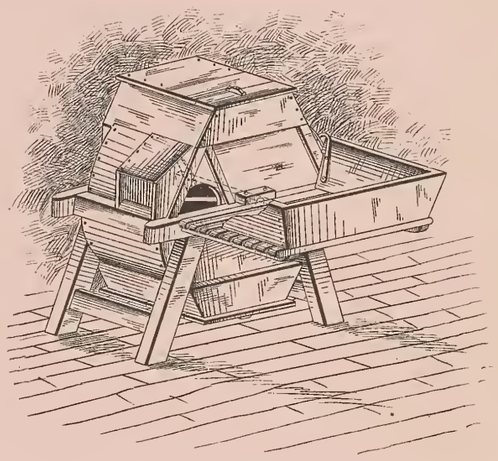
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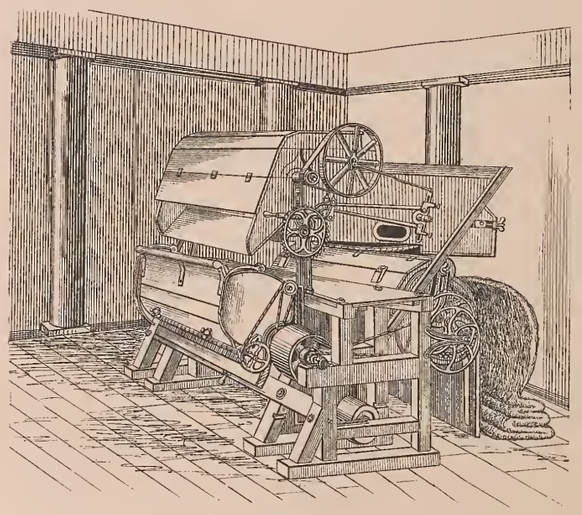
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COTTON GINNING AND CLEANING.

COTTON GINNING AND CLEANING.

No. 1. Hindoo Foot Roller.
2. " Churka Gin.
3. Chinese Cleaner.
4. Hand Pulling.
5. U. S. Patent, Saw Gin—A. D. 1794.
6. " " Roller Gin—A. D. 1881.
7. " " Cotton Whipper—A. D. 1882.
8. " " Gin Feeder and Condenser—A. D. 1883.

In ancient times the natives of India literally separated cotton wool from the seed with their feet, and then cleaned it with their hands.

The foot roller has almost vanished, and the machine used is the churka. This simple implement is only one step in advance of the foot roller.

Until the invention of Whitney the separation of the fibre from the seed was entirely performed by hand. The cotton gin was invented by Eli Whitney, of Massachusetts, United States, in 1794. This invention revolutionized the culture and manufacture of the fibre by providing a mode of putting it into merchantable order at a reasonable price.

Many improvements have been made, but the original form of gin is still in use, and is said to meet all requirements.

COTTON GINNING AND CLEANING.

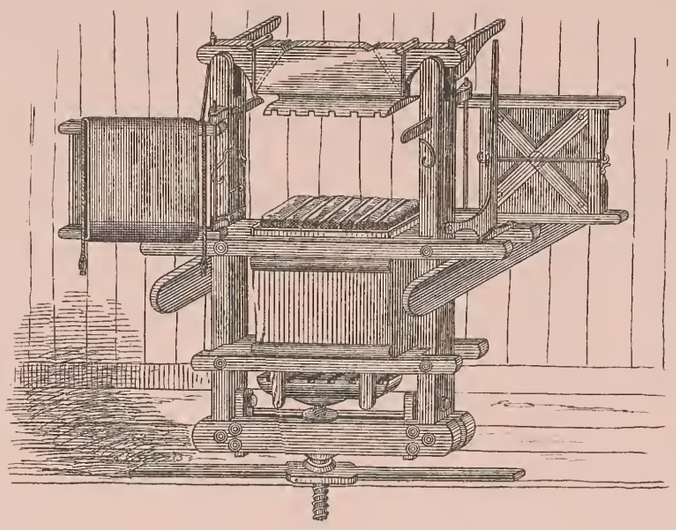
Capacity—	Primitive Mode.	Present Machine.
Pounds per day,	3	7,500
Hands employed per day,	1	1

470 Patents Granted by the United States.

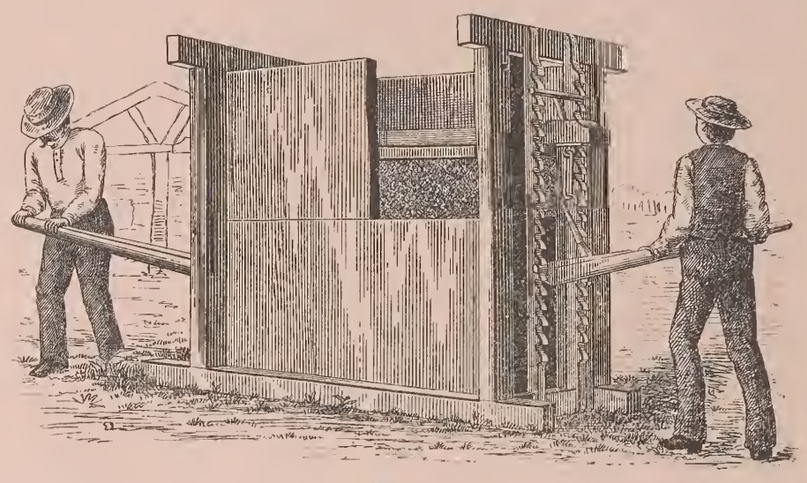
Sackett & Wilhelms Litho Co New York



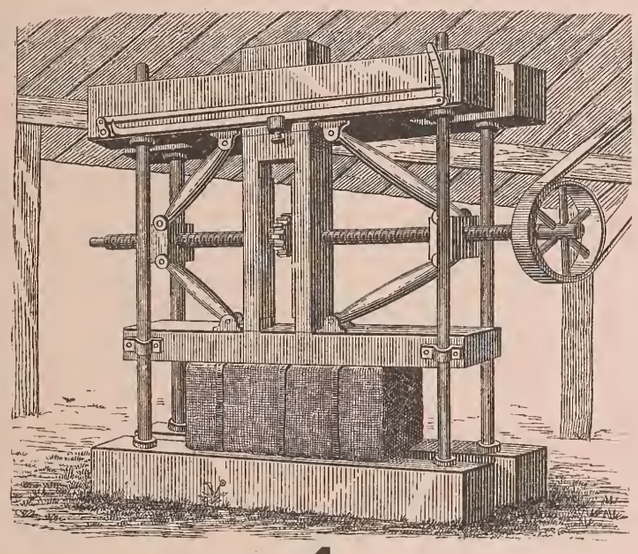
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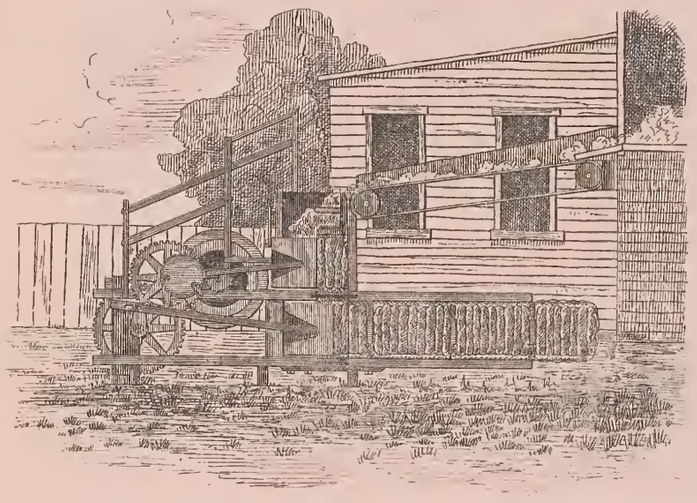
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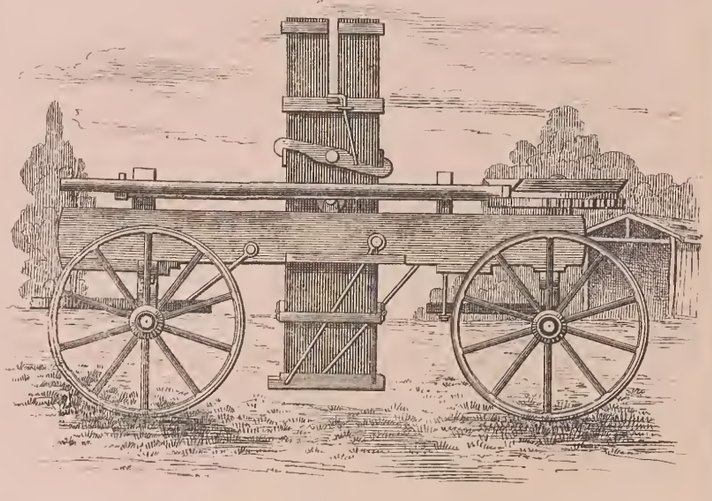
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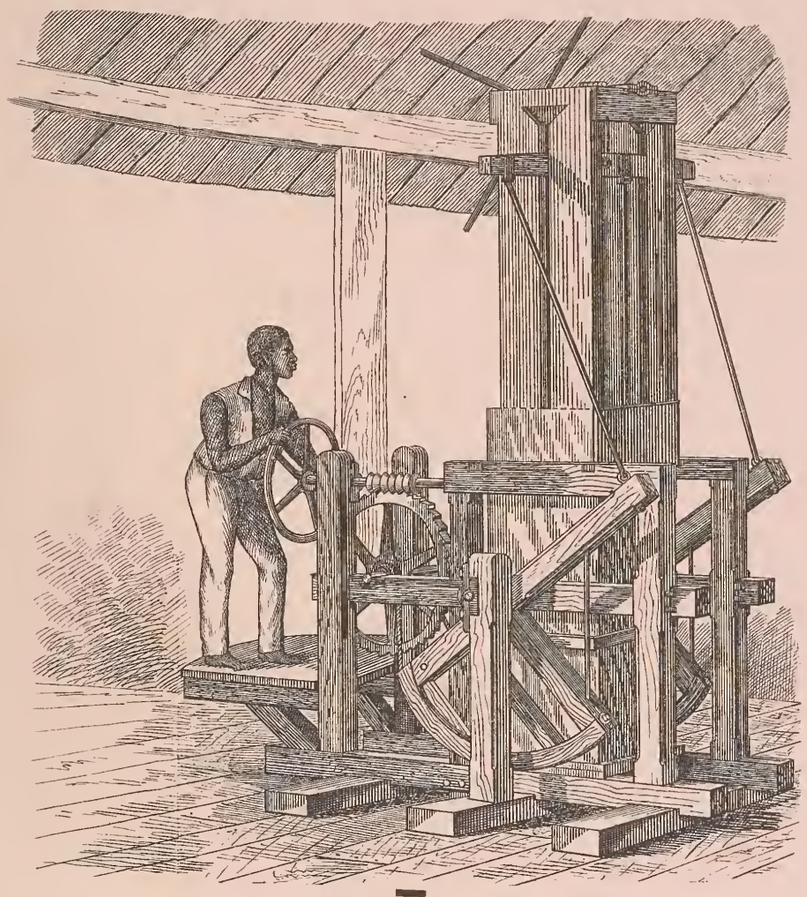
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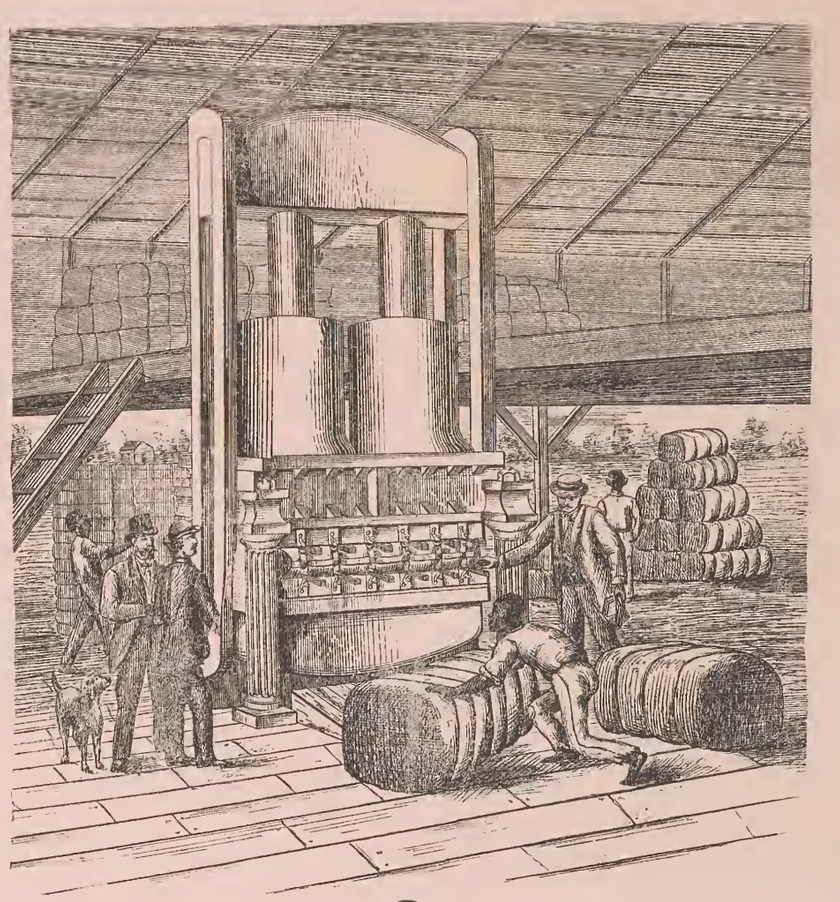
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8

COTTON PRESSES AND COMPRESSES.

COTTON PRESSES AND COMPRESSES.

No. 1. Wooden Compass.
2. U. S. Patent, Bottom Screw—A. D. 1870.
3. " " Hand—A. D. 1871.
4. " " Steam—A. D. 1876.
5. " " Self Feeder—A. D. 1882.
6. " " Portable—A. D. 1882.
7. " " Hand—A. D. 1883.
8. " " Compress—A. D. 1884.

The old form of cotton press was a screw which ascended vertically from the follower and worked in a nut in the upper cross-beam. It was rotated by a sweep.

The forms of cotton presses are known as the screw, toggle, beater, revolving, hydraulic, portable, double-acting, windlass, rack and pinion, repressing, and rolling pressure.

Cotton is first pressed in ordinary screw presses into bales of 450 to 550 pounds in weight. These bales are from 4 to 5 feet long, 3½ feet wide and 2½ feet thick.

The iron screw press is the latest invention, and is generally run by horse power.

When cotton is collected in large quantities for shipping, the hydraulic compress is used, and the bales are reduced to about one-half the original size.

The following are the dimensions of a cotton press with non-condensing engine:

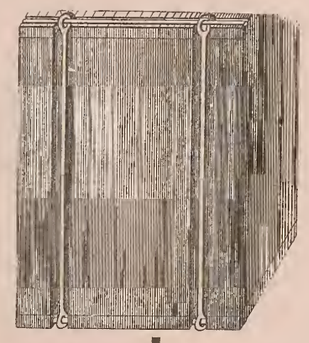
For one thousand bales in twelve hours—cylinder, fourteen inches in diameter by four feet stroke; pressure, forty pounds per square inch at full stroke; revolutions, sixty per minute; boilers, three, plain cylindrical, without flues, thirty inches in diameter by twenty-six feet in length; grates, thirty-two square feet; presses, four, geared six to one, with two screws each of seven and one-half inches diameter by one and five-eighths inches pitch; shaft, wrought-iron; journal, eight and one-half inches; fly-wheel, sixteen feet diameter, weight, four tons.

COTTON PRESSES AND COMPRESSES.

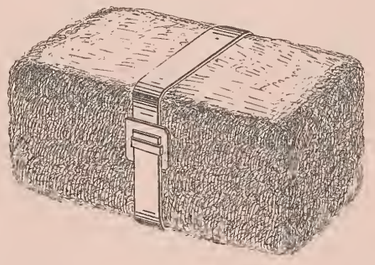
Capacity—	Primitive Mode.	Present Machine.
Bales per day, - - - -	15	1,000 compressed.
Hands employed per day,	8	8 "

1,259 Patents Granted by the United States.

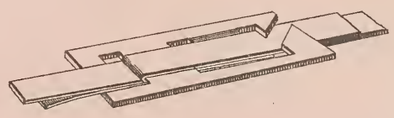
Sackett & Wilhelms Litho Co New York



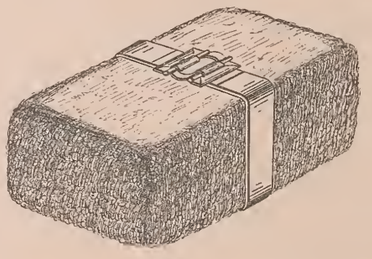
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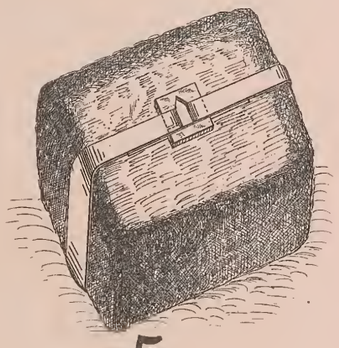
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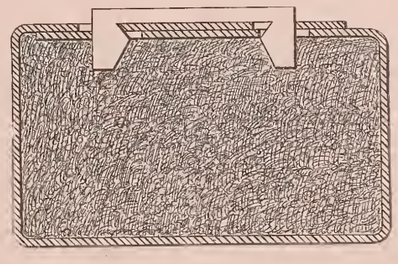
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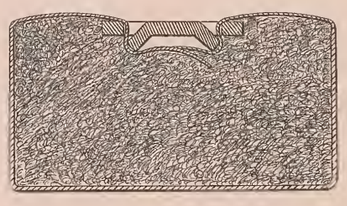
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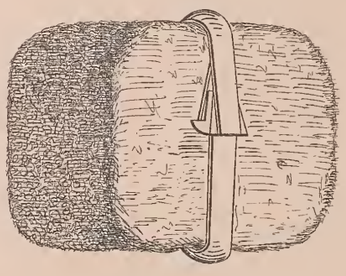
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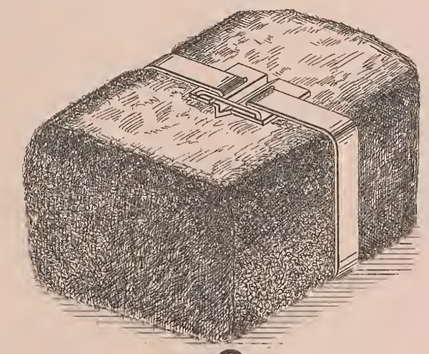
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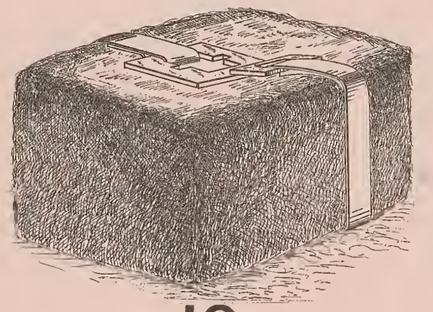
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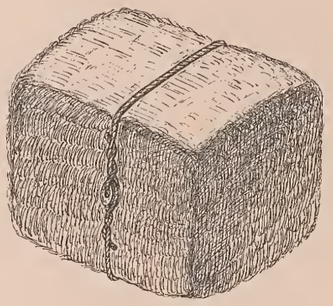
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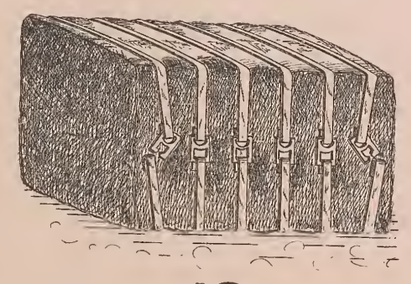
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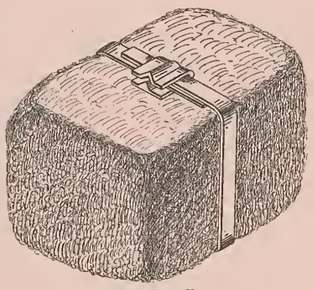
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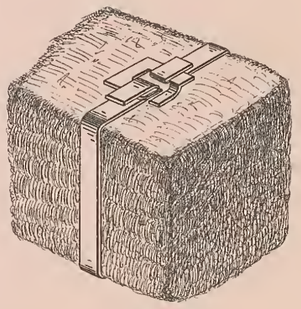
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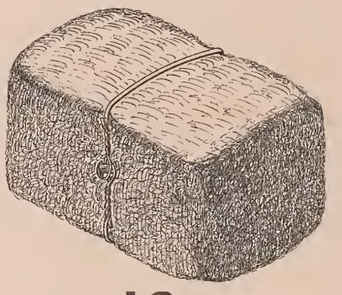
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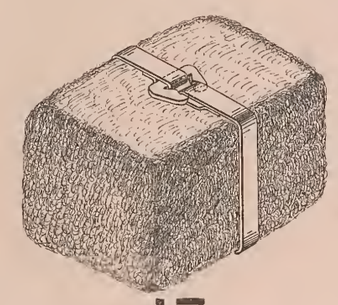
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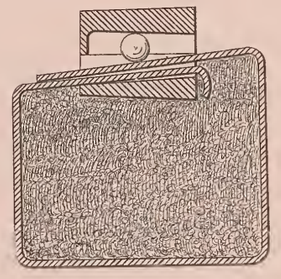
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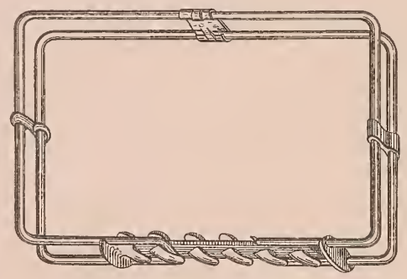
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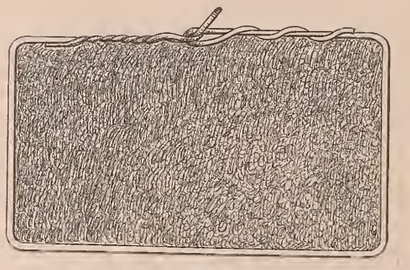
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COTTON BALE TIES.

COTTON BALE TIES.

No. 1. English—A. D. 1736.
2. U. S. Patent, Hook—A. D. 1856.
3. " " Buckle—A. D. 1858.
4. " " " —A. D. 1859.
5. " " Link—A. D. 1861.
6. " " Key—A. D. 1866.
7. " " Buckle—A. D. 1866.
8. " " Slot Lock—A. D. 1866.
9. " " Ridge Lock—A. D. 1866.
10. " " Notched Slot Lock—A. D. 1867.
11. " " Wire Rope—A. D. 1867.
12. " " Grooved Ring Wire—A. D. 1867.
13. " " Cleft Lock—A. D. 1870.
14. " " Ridge Lock—A. D. 1871.
15. " " Anti-Slipping Lock—A. D. 1871.
16. " " Wire—A. D. 1875.
17. " " Lug Lock—A. D. 1879.
18. " " Ball—A. D. 1880.
19. " " Wire—A. D. 1880.
20. " " Wire—A. D. 1884.

Cotton bale ties are devices for fastening the ends of loops, by which bales of cotton are held in compact form.

Almost all cotton bales are now bound with iron ties made of steel iron of great tensile power.

One of the simplest ties used is that of turning back about an inch of each end of the tie, lapping these into each other, and slipping a band of the same material in the tie, over the lap.

It is stated that about 75,000 miles of hoop iron will be required to bind the cotton crop of the year 1885, if it reach the number of bales predicted by statisticians as 6,000,000. Six bands are used to a bale. They are made about 11 feet in length, and 1,200 bands weigh a ton.

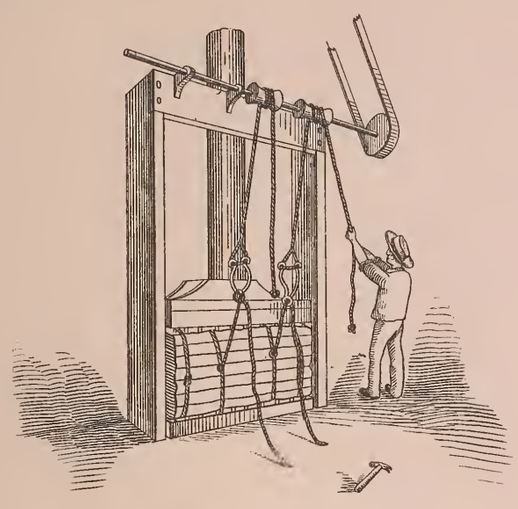
COTTON BALE TIES.

6 Manufactories in the United States.

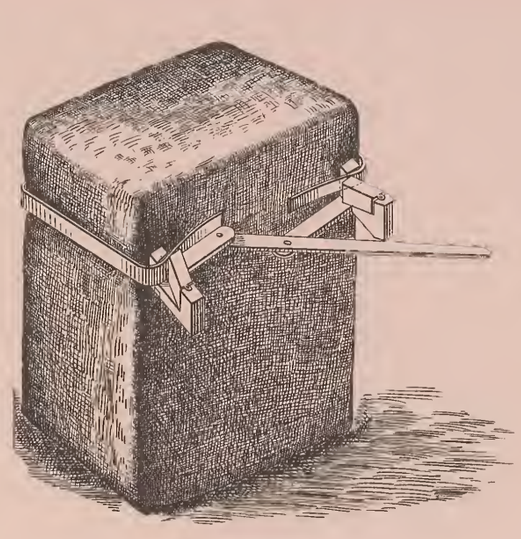
	1880
Capital Invested,	$70,500.00
Value of Productions,	262,351.00
Wages Paid,	38,069.00
Hands Employed,	131

750 Patents Granted by the United States.

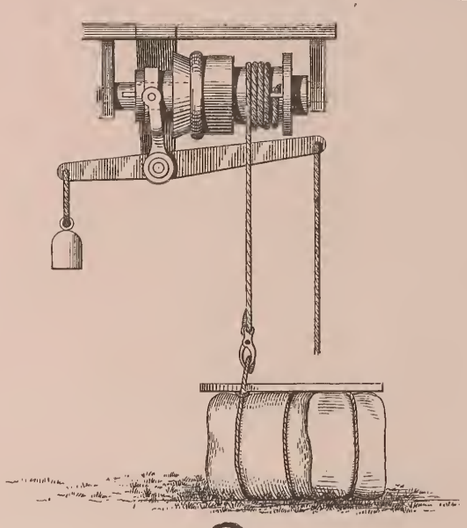
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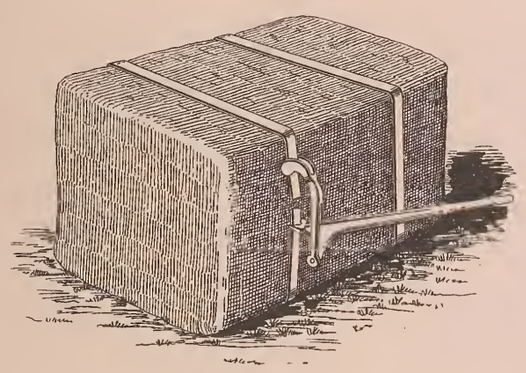
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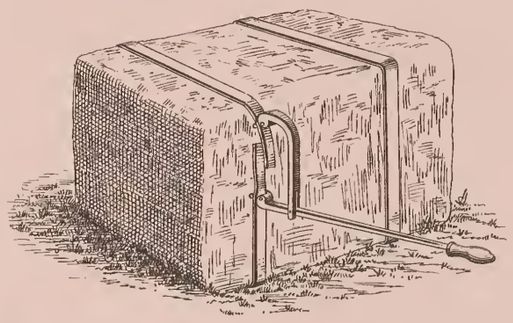
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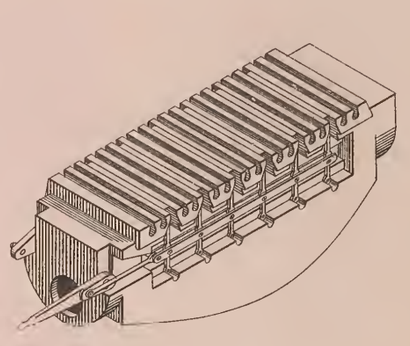
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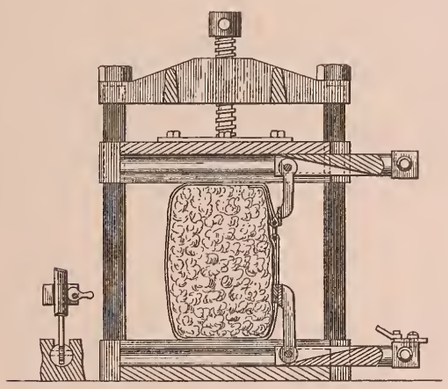
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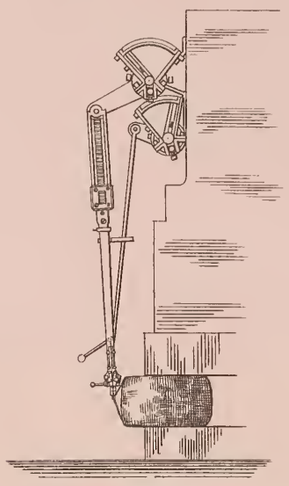
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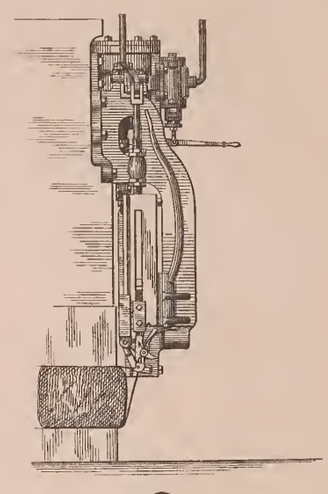
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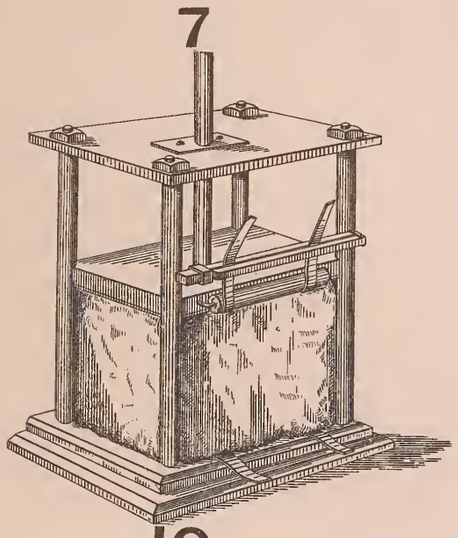
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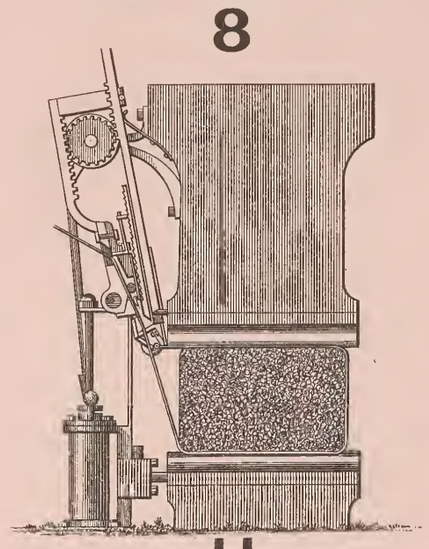
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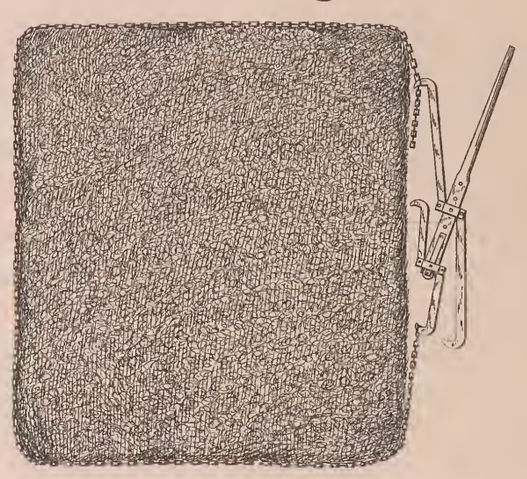
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BALE BAND TIGHTENERS.

BALE BAND TIGHTENERS.

No. 1. U. S. Patent, Rope—A. D. 1848.
2. " " Grapple Lever—A. D. 1858.
3. " " Rope—A. D. 1861.
4. " " Grapple Lever—A. D. 1866.
5. " " Stretcher—A. D. 1872.
6. " " Toggle—A. D. 1876.
7. " " Hoop Tightener—A. D. 1876.
8. " " Steam Power—A. D. 1876.
9. " " " " —A. D. 1879.
10. " " Re-tying—A. D. 1879.
11. " " Steam Power—A. D. 1880.
12. " " Gripper—A. D. 1884.

Bale band tighteners have been invented of many varieties. One of the latest tighteners consists of a lever with a forked claw or hook, by which the bale tie is drawn to its utmost tension.

The average quantity of cotton contained in each kind of bale is as follows: United States, 444 pounds; Brazil, 162 pounds; Egypt, 492 pounds; Turkey, 345 pounds; West Indies, 180 pounds; Surat, 382 pounds; Bengal, 300 pounds. The general average is, therefore, 400 pounds.

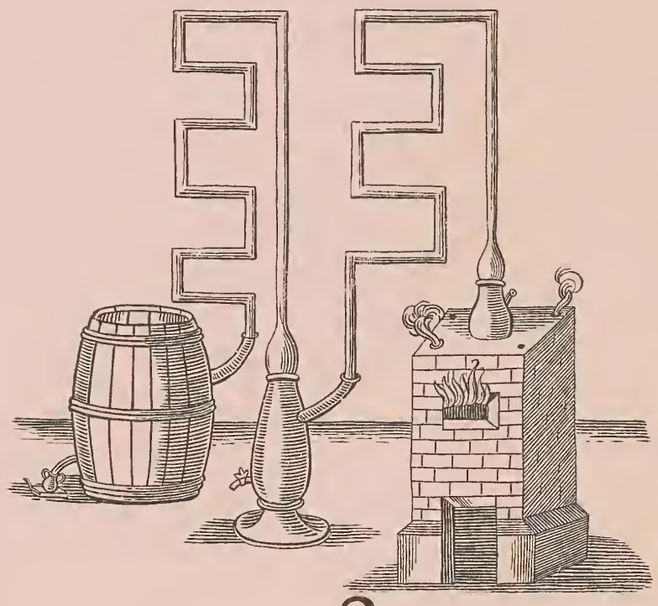
BALE BAND TIGHTENERS.

81 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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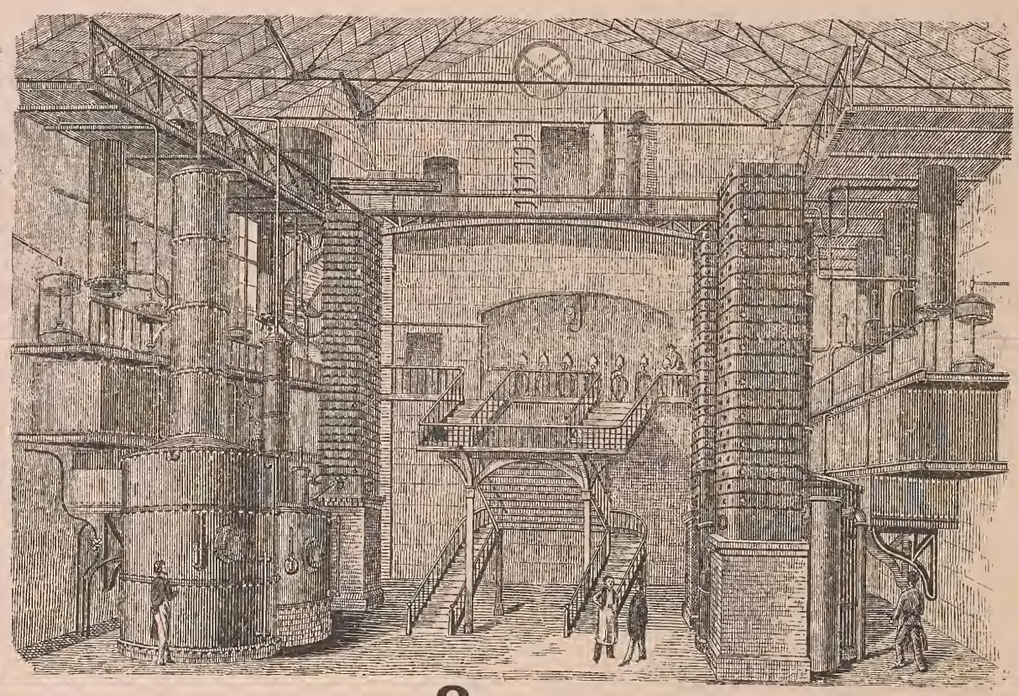
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8

DISTILLATION.

DISTILLATION.

No. 1. Primitive English Still.
2. English Still, 16th Century.
3. Thibet Still.
4. Cingalese Still.
5. Tahiti Still.
6. Peruvian Still.
7. Irish Poteen.
8. U. S. Patent, Distillery— A. D. 1884.

The first mention of the distillation of a fluid is of fresh water from sea water, and is found in the Commentaries of Alexander.

Zozamus, 400 B. C., described the operation of purifying water. The Arabs called the apparatus "an alembic."

Rhayas, the chief surgeon of Bagdad, A. D. 860, discovered absolute alcohol by distilling spirits of wine.

Europe owes its knowledge of the art of distillation to the Arabs. Alcoholic spirits were never used by the Mahommedans

Distillation from grain is of much later origin. Continuous distillation was carried out first by Bagholi, and improved by Blumenthal and Derosny. Downs' still was one of the earliest invented, and is still used in Germany.

The art of distilling whiskey is said to have been introduced into Great Britain by the soldiers of the Scotch army, stationed during the rule of Cromwell in the north of Scotland. They brought the product down among the lowlanders and sold it as whiskey.

The first United States patent for distilling apparatus was granted Aaron Putnam, January 29, 1791.

The cereals which are used for distillation are barley, rye, rice, wheat, oats and corn.

There are six operations indispensable to fit grain for the process of fermentation: 1st, steeping; 2d, germination; 3d, drying the sprouted grain; 4th, grinding; 5th, mashing; 6th, infusion.

Alcohol is also made from sorghum cane, figs and rice.

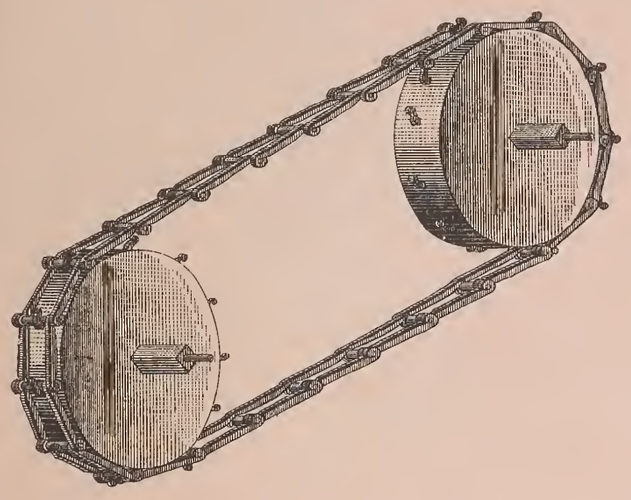
DISTILLATION.

844 Manufactories of Distilled Liquors in the United States.

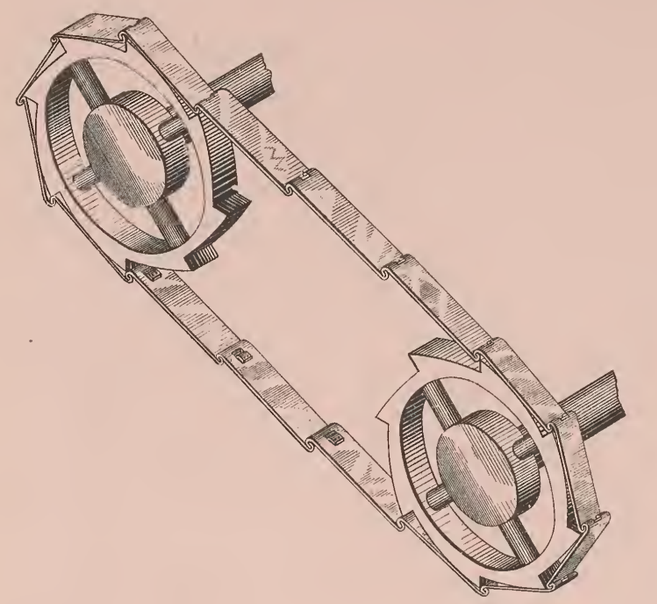
	1860	1880
Capital Invested,	$11,548,675.00	$24,247,595.00
Value of Productions,	26,768,225.00	41,063,663.00
Wages Paid,	1,753,445.00	2,663,967.00
Hands Employed,	5,416	6,502

831 Patents Granted by the United States.

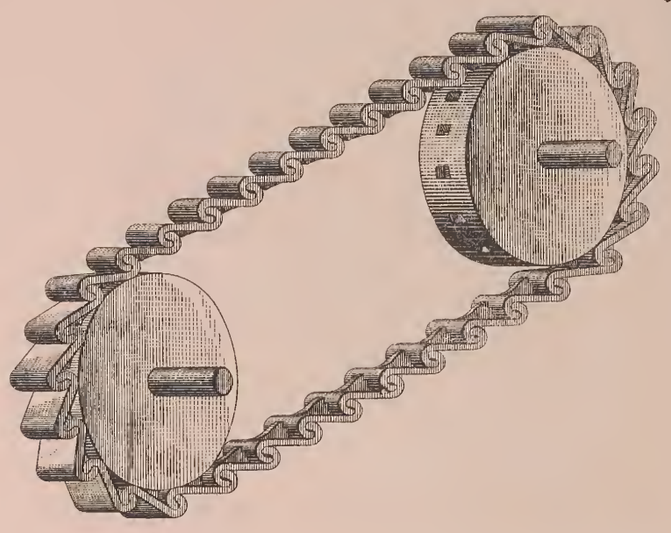
Sackett & Wilhelms Litho Co New York



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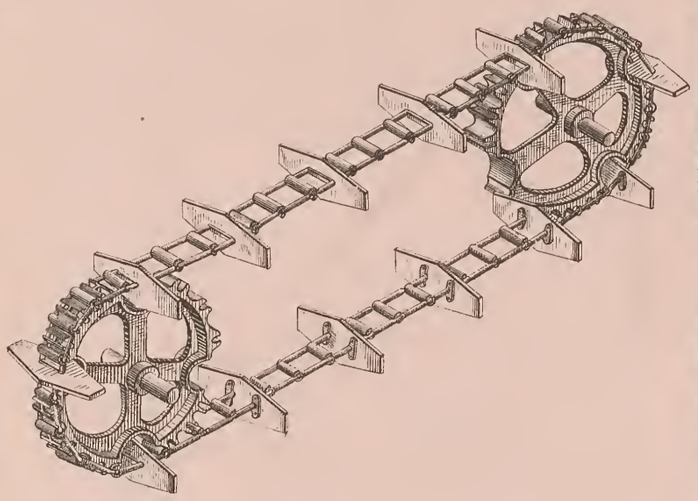
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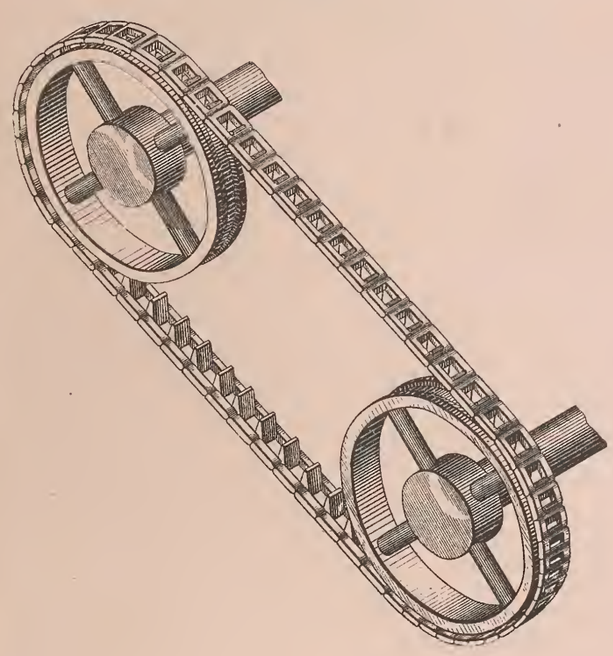
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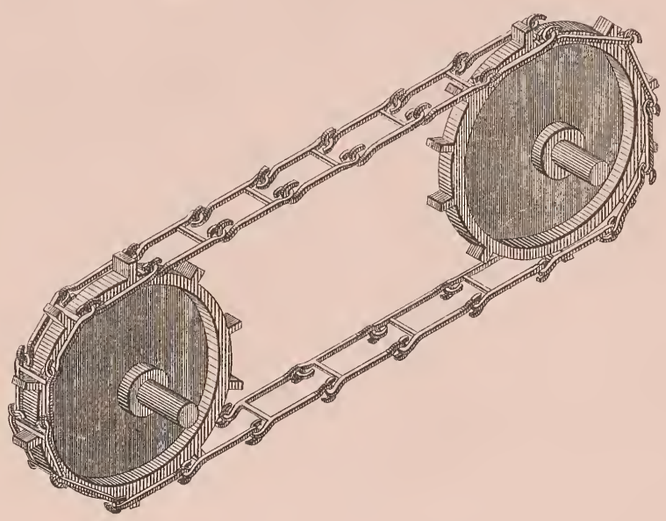
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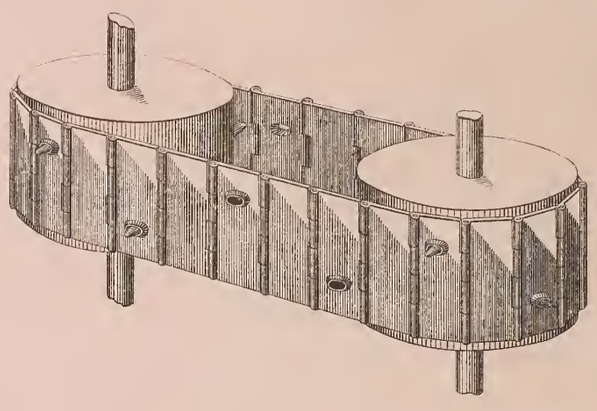
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DRIVE CHAINS.

DRIVE CHAINS.

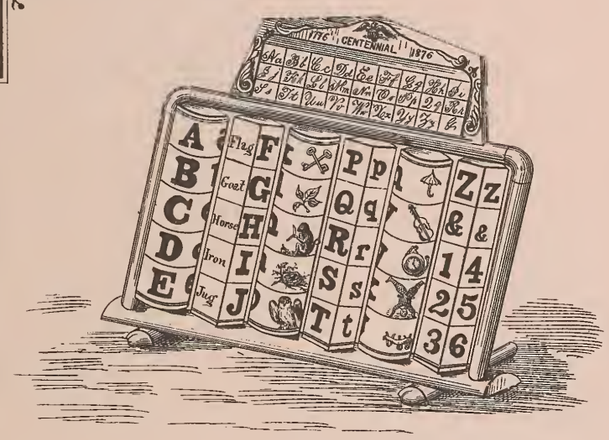
No. 1. Non-Detachable—A. D. 1724.
2. U. S. Patent, Knife Edged Link—A. D. 1860.
3. " " Cog Chain—A. D. 1867.
4. " " Elevator—A. D. 1874.
5. " " Conveyor—A. D. 1880.
6. " " Log Carrier—A. D. 1881.
7. " " Friction Chain Belt—A. D. 1881.
8. " " Spring Metal—A. D. 1882.
9. " " Endless Metal Belt—A. D. 1882.

The drive chain consists of a detachable link chain used in connection with sprocket wheels to drive machinery; each link has a hook and bar at its respective end, and these may be connected in certain relative positions, but cannot be detached when stretched.

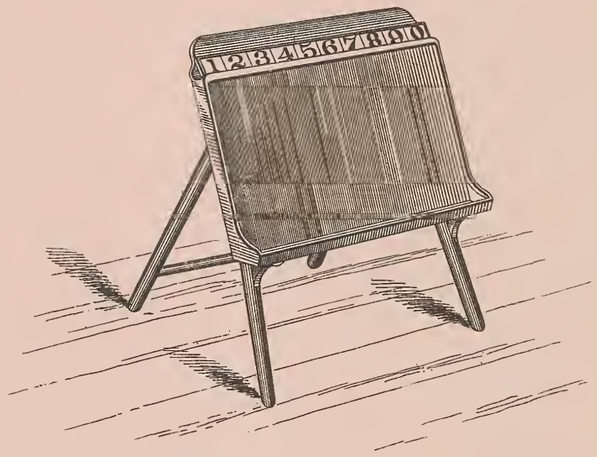
DRIVE CHAINS.

129 Patents Granted by the United States.

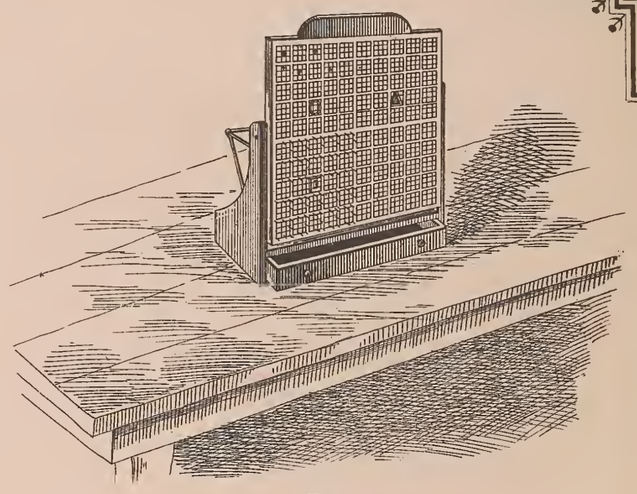
Sackett & Wilhelms Litho Co New York



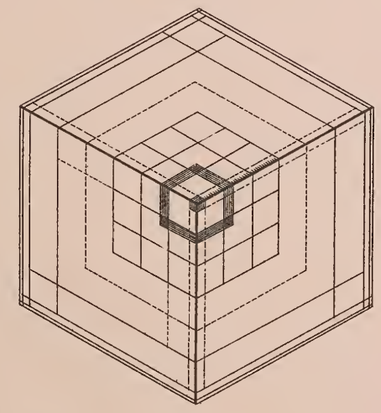
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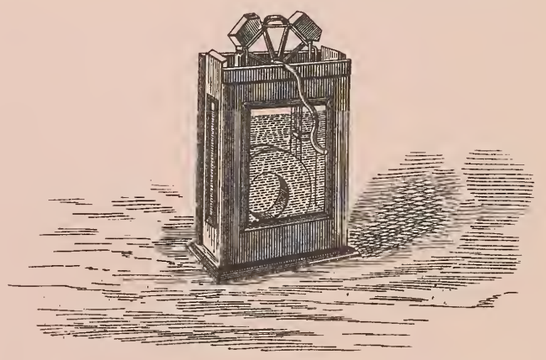
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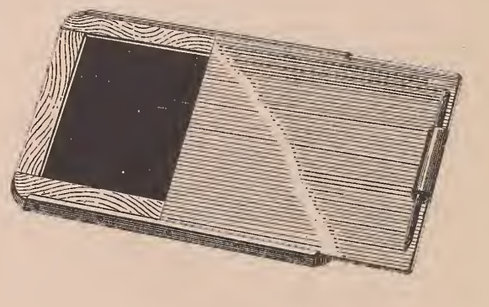
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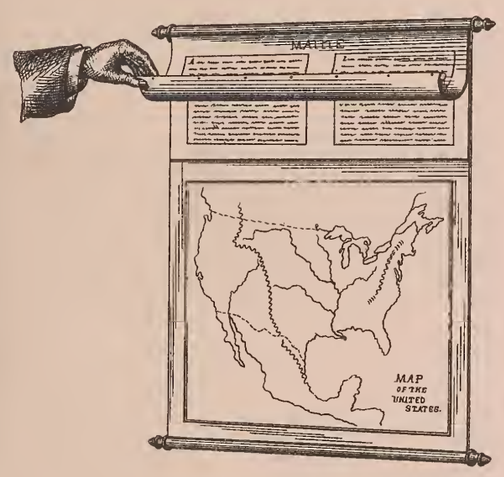
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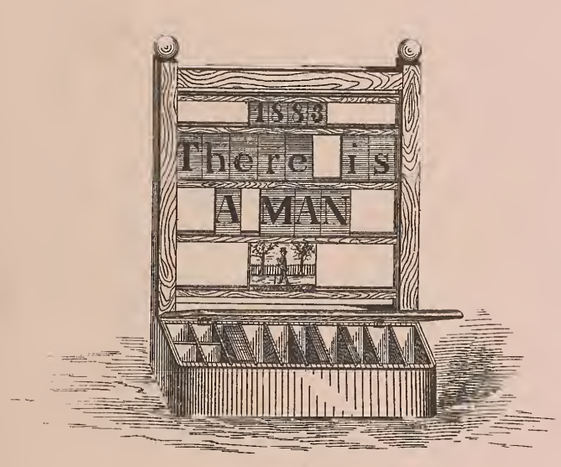
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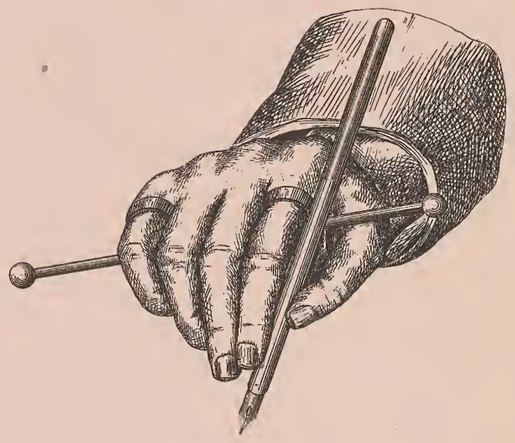
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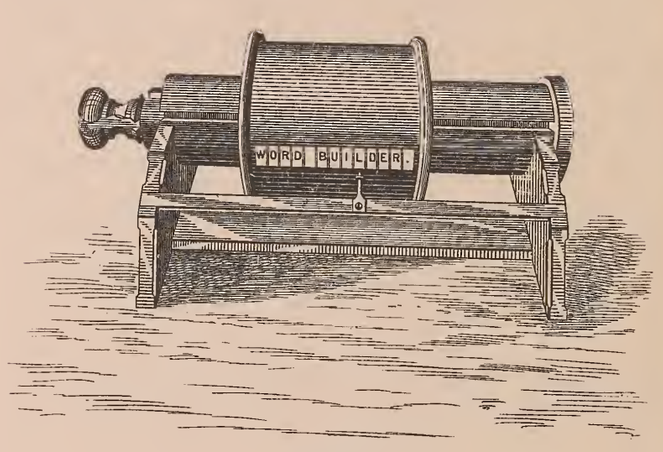
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12

EDUCATIONAL APPLIANCES.

EDUCATIONAL APPLIANCES.

1. U. S. Patent, Letter Block Apparatus—A. D. 1875.
2. " " Blackboard—A. D. 1877.
3. " " Teaching History—A. D. 1878.
4. " " Teaching Involution and Evolution—A. D. 1878.
5. " " Showing Aeration of Water—A. D. 1879.
6. " " Sliding Cover Slate Frame—A. D. 1880.
7. " " Index Sheet Maps—A. D. 1880.
8. " " Drawing Slate Attachment—A. D. 1882.
9. " " Slate Frame Muffler—A. D. 1883.
10. " " Interchangeable Chart Frame—A. D. 1884.
11. " " Finger Guide & Holder for Writing—A. D. 1884.
12. " " Instrument for Spelling & Reading—A. D. 1884.

Teaching, like everything else, came from the East, descending from the Hindoo Kosh with the migratory waves of population, which spread from those periods of time commencing so far back that history loses itself in tradition.

The Egyptians, even before the time of the Shepherd Kings, had regular school houses and school appliances, such as their advancement in civilization required. A celestial globe was taken from Egypt to Greece by the returning legions of Alexander the Great, made, possibly, by the men who constructed the pyramids of Cheops.

The Moors and Arabs were teaching geography from globes in their schools at the time the Romans and the descendants of their conquering legions were holding that the earth was flat, and it is possible that Columbus obtained the ideas from their schools that caused him to venture forth westward in search of the "Eastern Indies and Cathay," or he might have visited the school at Rheims, where Pope Sylvester II, in the year 1000 A. D., taught geography from a globe brought from the Moorish school at Cordova.

The primitive log cabin, with dirt floor, wooden benches, and common blackboard, has given way to the well constructed school house built after the best rules of architectural science, well lighted and heated. The benches are gone, the blackboard is a work of art, and covers one entire side of the school room, and the only other appliances of the old log school house, the master's formula and a bundle of willow, hickory or birch switches, are nowhere to be seen, but in their place we find many modern appliances.

Opposite the Principal is a school thermometer. A glance from teacher or scholar across the room will tell the temperature—whether it has risen or fallen from the proper degree. Upon the wall near it are raised maps, showing the countries of the world, with their mountain ranges, &c. Instead of the old smooth ball, with clumsily defined lines upon it, there stands a globe, with each section of the world raised up out of the waters that surround it. Near it is another globe made of slate, on which the student can draw with a slate pencil any portion of the earth's surface.

A cabinet near by, with doors which fold in and are fitted with shelves, contains specimens of various minerals, whilst the doors and shelves show varieties of woods. The walls of the building are covered with maps, on which are raised figures of animals, birds and fishes, all in proportion.

Another cabinet contains the figures and demonstrations of mathematical problems, and still another, anatomical specimens.

Modern globes are made of paper or plaster, neither of which is affected by changes of temperature, also of gutta-percha and paper pulp.

Even the blind are provided for, in these modern appliances, with raised type, and maps and globes with raised figures.

EDUCATIONAL APPLIANCES.

479 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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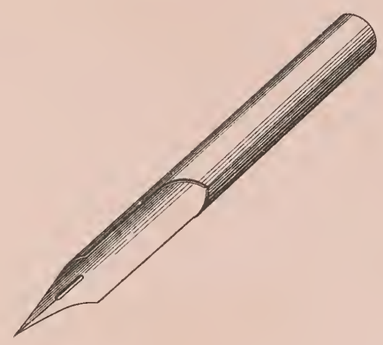
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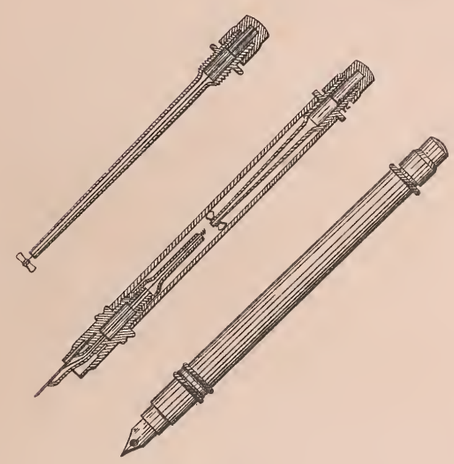
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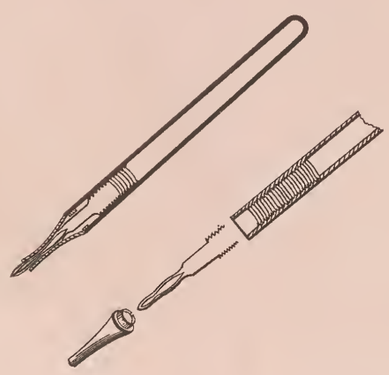
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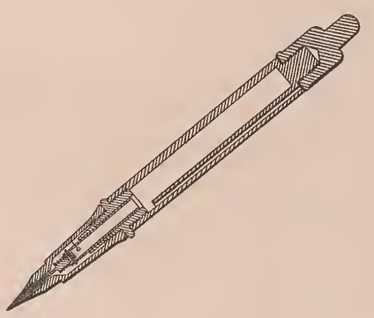
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9

PENS.

PENS.

No. 1. Stylus O.
2. Writing Brush, Japanese.
3. Reed, Egyptian.
4. Quill.
5. First Steel—A. D. 1803.
6. U. S. Patent, Fountain—A. D. 1843.
7. " " Stylographic—A. D. 1850.
8. " " Fountain—A. D. 1881.
9. " " Stylographic—A. D. 1881.

The earliest pen was a kind of iron bodkin or dagger, and it is still in use for writing on leaves of ivory and for transferring drawings. By the word pen, in the translation of the Bible, we are to understand an iron stylus. The ancients used the stylus which was made sharp at one end to write with, and blunt and broad at the other to erase and correct with easily.

The Romans forbade the use of the metal stylus, because many persons used them as daggers, and substituted those made of the bones of birds.

Pens made of reed were in use forty centuries ago for writing with a fluid on papyrus. Quills are said to have been introduced in the fifth century.

The first metallic pens were introduced for sale by Mr. Wise, of London, England, in 1803; they were in the form of a barrel, adapted to slip on a stick; they were not popular and were very expensive.

In 1820, Joseph Gillott, of England, commenced the manufacture of steel pens of high finish and temper.

Doughty first made gold pens in 1825.

Perry obtained patents in 1830 and 1832 for developing the elasticity of pens.

Fountain pens were first introduced in 1835.

The quill pen maintained its position until 1836, and even later remained the favorite with many.

Poland and Russia raise immense flocks of geese for their quills, and Russia has furnished England as many as 27,000,000 quills per year.

To render the quills fit for use they are dried in hot sand, stripped of the outside skin, and hardened in boiling alum or diluted nitric acid.

About 1840, Levi Brown, of Detroit, Michigan, succeeded in making and introducing gold pens.

In 1844, John Rendell, in the employ of Mr. Brown, invented machines for making gold pens, and to his invention the American gold pen is principally due.

The manufacture of gold pens is carried to the highest perfection in the city of New York, whence they are sent to all parts of the world.

Twenty years ago most of the steel pens used in the United States were imported. At the present time great quantities are made in the United States, and comparatively few are imported. The American steel pen has become famous in all parts of Europe, and large quantities are exported yearly.

Early attempts to compete with English manufacturers were unsuccessful.

Thirteen hundred tons of steel are consumed annually in the manufacture of pens. 1,000,000,000 are produced yearly in England.

It is estimated that about 1,000,000,000 pens are worn out every year in the United States.

The modern fountain pen has obtained much favor; the ink is contained in a hollow handle, the pressure in writing carrying the fluid to the point as required.

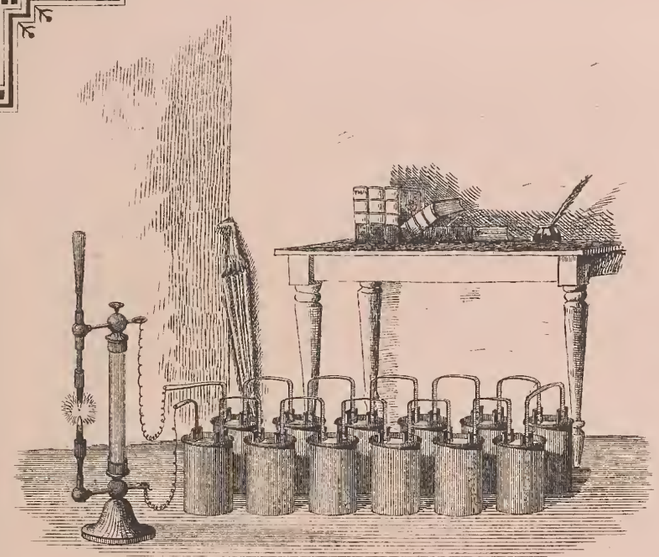
PENS.

19 Manufactories of Pens in the United States.

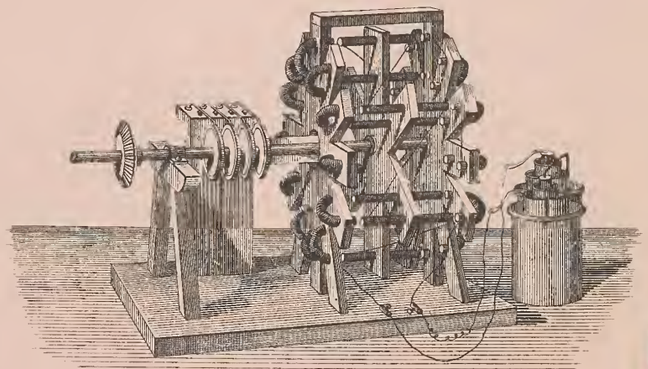
	1880
Capital Invested,	$552,650.00
Value of Productions,	697,061.00
Wages Paid,	265,707.00
Hands Employed,	544

350 Patents Granted by the United States.

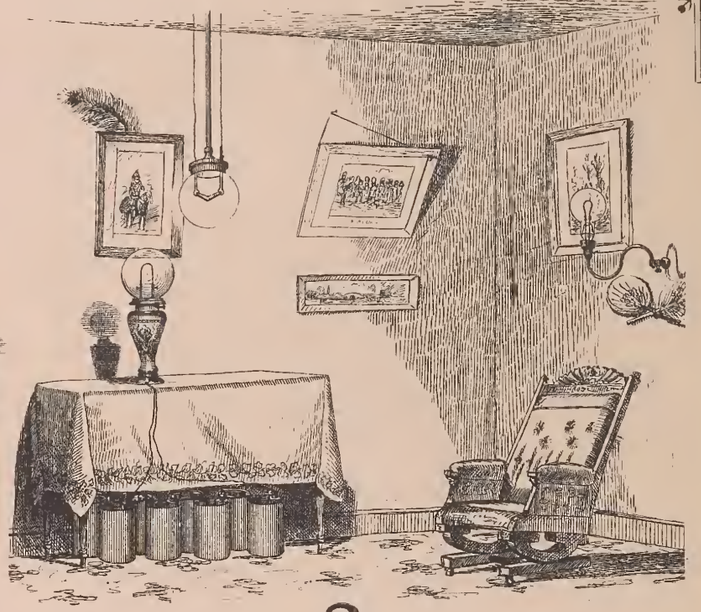
Sackett & Wilhelms Litho Co New York



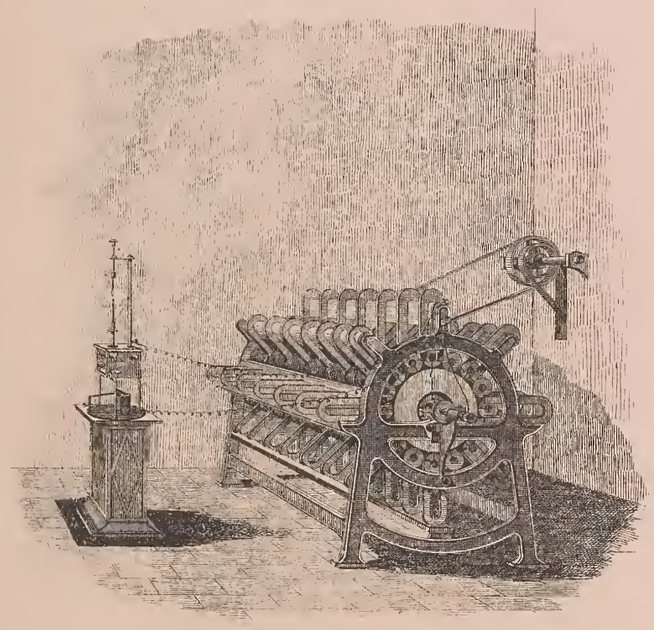
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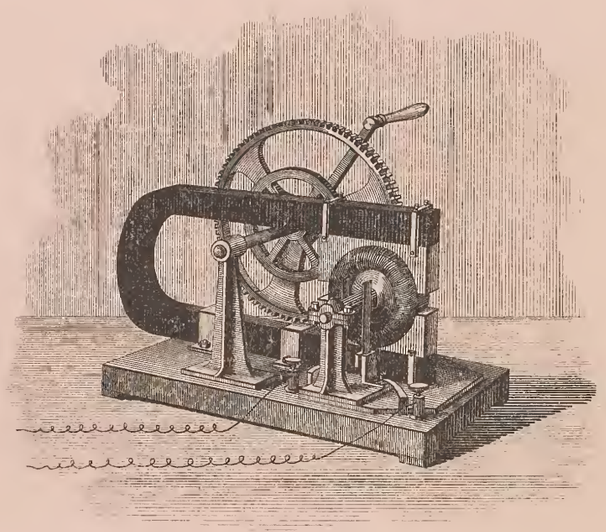
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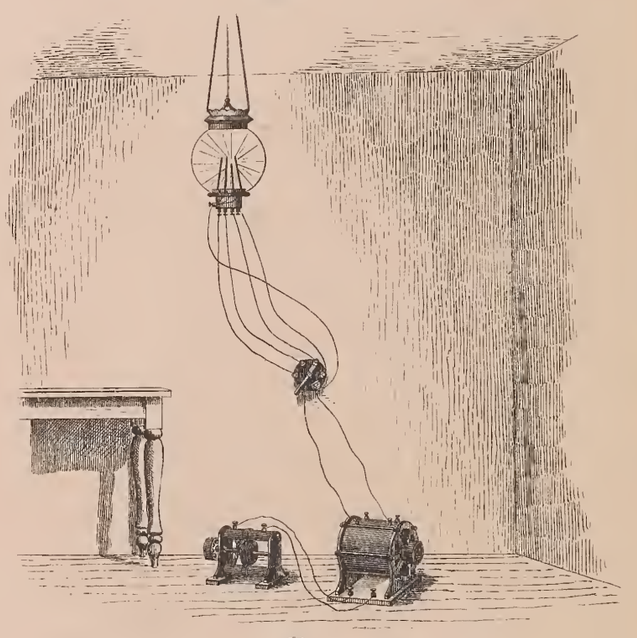
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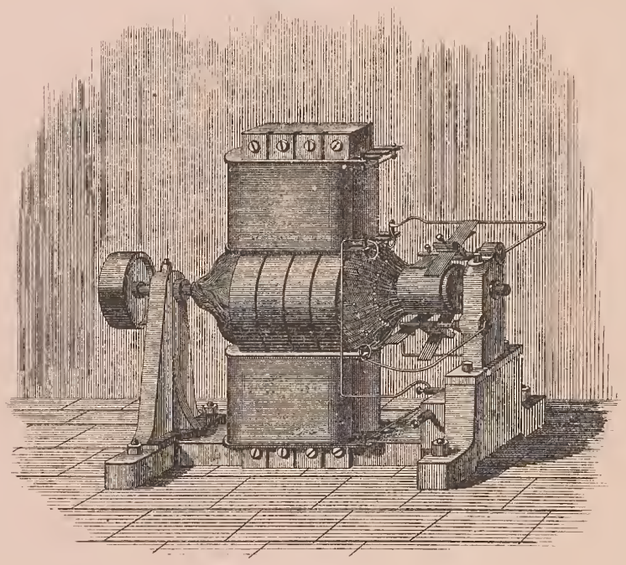
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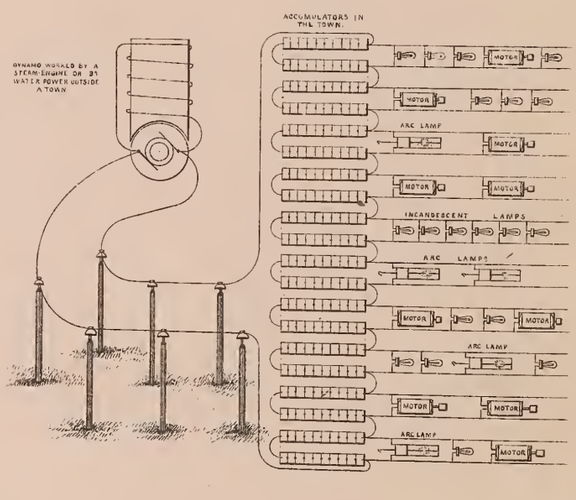
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9

ELECTRIC ILLUMINATION AND MOTORS.

ELECTRIC ILLUMINATION AND MOTORS.

1. Electric Lighting—A. D. 1813.
2. Electric Motor—A. D. 1838.
3. U. S. Patent, Incandescent Lamps—A. D. 1848. 1873. 1878.
4. " " Magneto Machine and Arc Light—A. D. 1850.
5. " " " " " —A. D. 1871.
6. " " Magneto Generator & Electric Candle—A. D. 1877.
7. Electric Railway—A. D. 1880.
8. Dynamo—A. D. 1883.
9. Transmitting Energy from Distant Sources of Power for Lighting, &c.—A. D. 1883.

Electricity is derived from the Greek *elektron*, meaning amber, that being the first substance in which the existence of an electric fluid capable of being excited and accumulated was observed by Thales, of Miletus, in 600 B. C.

Electricity as a science, however, was first written of by William Gilbert, a London physician, A. D. 1600.

Boyle, about 1670, discovered that a diamond became electrical, and emitted light in a dark room, when friction was applied to it; and Hawkshaw, in 1709, discovered the electrical properties of glass.

The first electrical machine was made by Otto de Guerricke, of Magdeburgh, in 1660. It was a globe of sulphur, but glass cylinders were soon found to be more powerful.

Up to 1750, however, the friction was applied by the dry hand of the experimenter, until the cushion and silk floss were invented by Winckler, of Leipsic.

Metallic conductors originated with Stephen Gray in 1734, and though the accumulation of electric power in coated jars was discovered in 1745 by M. Von Kleist, Dean of the Cathedral in Corunna, the subsequent experiments of Cuneus, of Leyden, have been preserved in the Leyden jar.

The electrical battery was discovered by Gralable, a German electrician.

Electricity was first applied to medical purposes by Kratzenstein, at Halle, in 1744.

In 1752 Franklin demonstrated the identity of lightning with the electric spark, and drew electricity from the clouds.

The first patents for electricity in the U. S. Patent Office were issued to D. Harrington, of Philadelphia, in 1833, '34, and '35, to cure disease.

The electric light was first brought into notice in this country by Greener & Straite, who took out a patent in 1846 for a light generated by the combustion of two carbon points.

The magneto-electric light was first applied for illuminating purposes at the lighthouse at Dungeness, England, in 1862, and was introduced at La Hève, France, a year or two later.

In this country the first patent for a dynamo was issued to Moses G. Farmer in 1875, which was similar in its construction to the series wound reactionary dynamos now found in general use.

Brush, with his dynamo and improvements upon arc lamps, came two years later.

The first patent for an improvement in the arc light was granted to Collier & Baker in May, 1858. It consisted of two electrodes of carbon; the upper carbon was prevented from contact with the lower by a retaining diaphragm of metal, through which a point projected. It acted by a mercurial feed, the carbons being forced forward by the mercury in which they were immersed. As a practical lamp, it was not a success.

The electric light may be said to have been in general use in this country since 1878.

In 1838 Jacobs propelled a small shallop on the river Neva, near St. Petersburg, in Russia, at the rate of four miles an hour, three miles against the stream. He had four fixed electro-magnets, and the same number of revolving ones, to which the axle that carried the paddle wheels was attached. His battery, consisting of sixty-four pairs of platinum plates, each presenting a surface of thirty-six square inches, was charged with nitric and sulphuric acid on Grove's plan.

In 1849 Prof. Page propelled a car on the tracks of the Baltimore and Ohio Railroad from Washington to Bladensburg—a distance of six miles—at the rate of nineteen miles an hour.

The patent for the Page motor was granted January 21, 1854. In this motor the two armatures consist of long cores of wire, which are adapted to slide with an oscillatory motion through two pairs of solenoids, made up of successive sections, which are brought into action by sliding commutators actuated by rods from eccentrics on the fly wheel shaft, being entirely analogous to the cut-off mechanism used in a steam engine.

The use of electricity as a motor is not general, as it has not yet been sufficiently demonstrated that it is cheaper than coal.

Prof. Ayrton, however, states that the cost of coal for producing power is £790,000 a year in Sheffield alone, and that electricity can supply this want; and according to Sir William Thomson, the source of power by this means would be 133 times as cheap.

ELECTRIC ILLUMINATION AND MOTORS.

Denoting the cost of Electric Arc Light of the intensity of one standard candle by 1

The cost of wax candles of the same intensity is . . . 75

" stearin " " . . . 55

" oil " " . . . 16

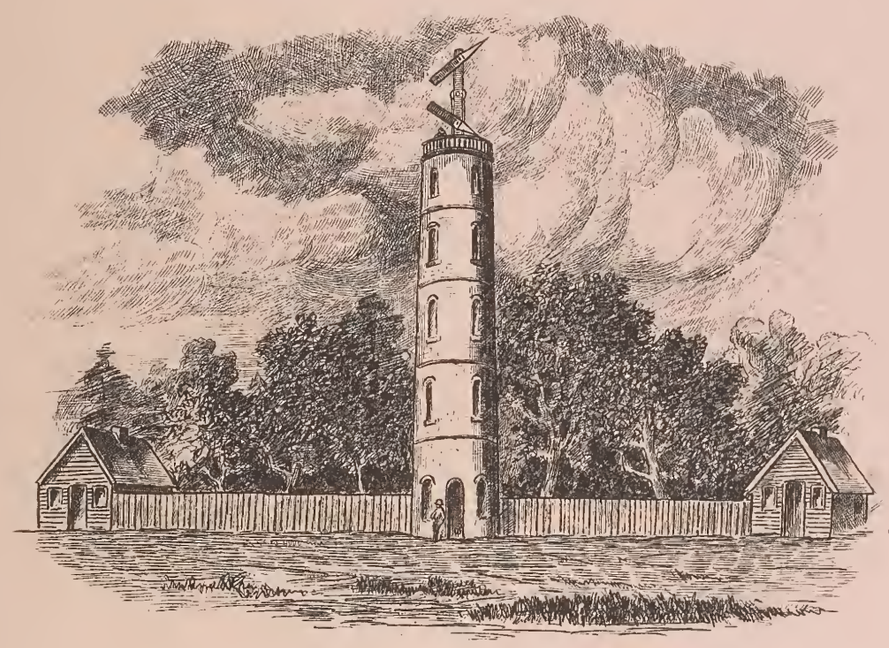
" gas " " . . . 8,5

1,366 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



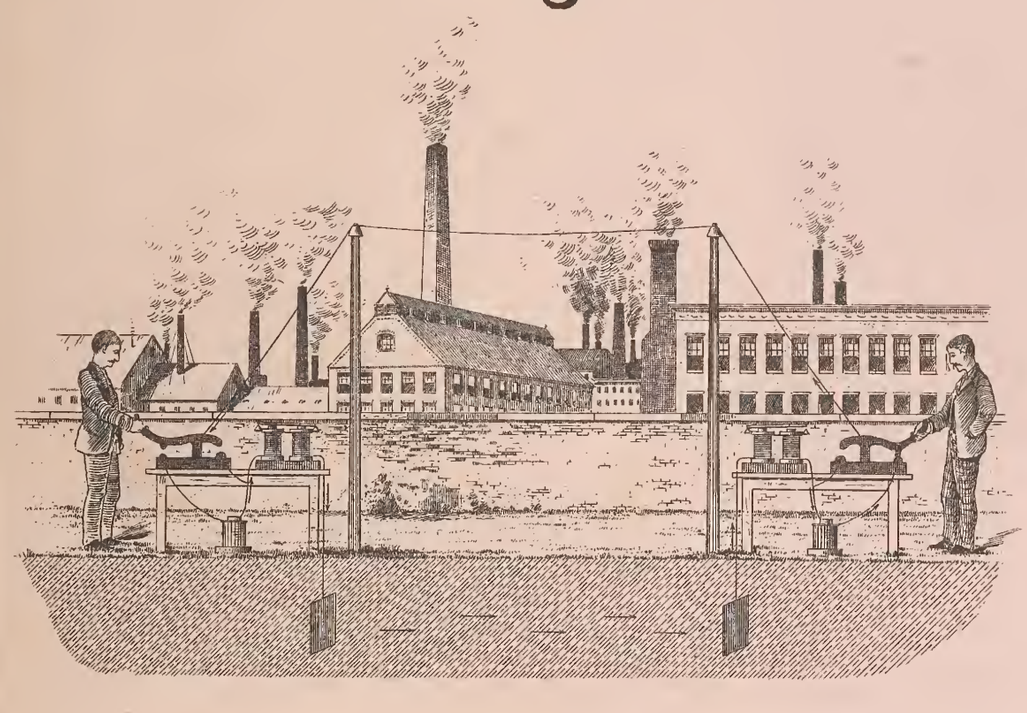
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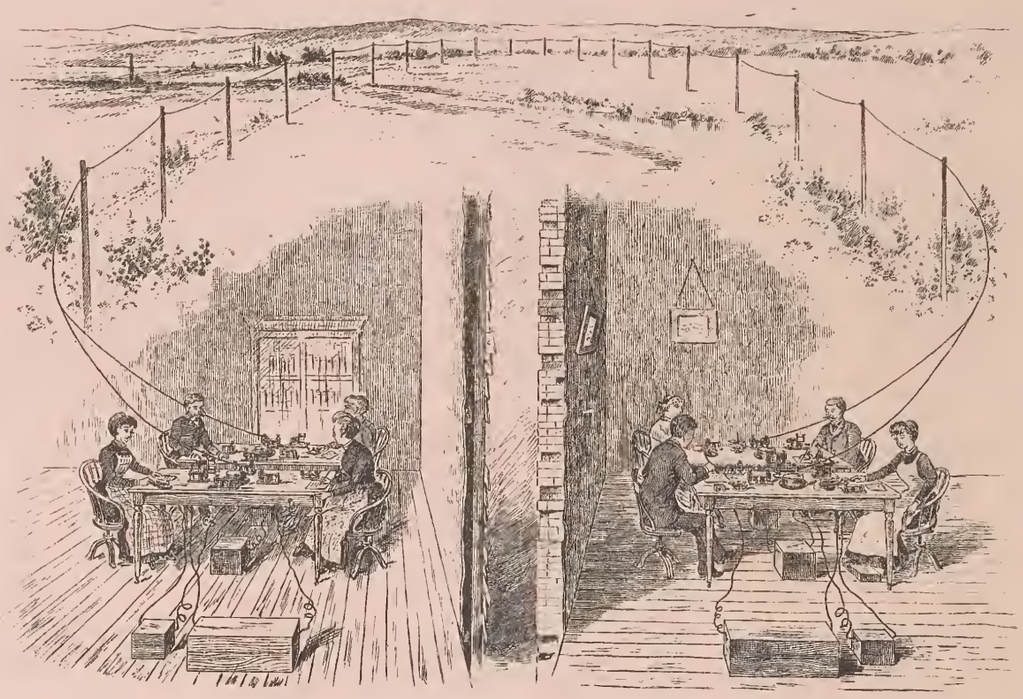
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TELEGRAPHY.

TELEGRAPHY.

No. 1. Indian Signal.

2. Franklin's Experiment—A. D. 1752.

3. Semaphore Signal—A. D. 1776.

4. Electric Telegraph—A. D. 1809.

5. U. S. Patent, Electro Magnetic Telegraph—A. D. 1840

6 " " Quadruplex " —A. D. 1884.

This is from two Greek words, *telos*, far distant, and *graphein*, to write.

The first patent granted for a telegraph in the United States was to J. Grant, of Massachusetts, in 1800.

The first telegraph erected in this country was on Long Island, by Harrison Gray Dyer, who used practical electricity, and dyed marks on chemically-prepared paper by means of electric sparks.

Although Prof. Morse is generally considered to be the father of the telegraph, as a matter of fact, Messrs. Wheatstone & Cook, of England, obtained a patent for their electro-magnetic telegraph on the 10th of June, 1840, while Prof. Morse's patent followed only ten days later. The Wheatstone & Cook apparatus was cumbersome, and never found a place among the practical inventions of the art in this country. It was, primarily, to Morse's apparatus, based upon his code of signaling and the use of a single line wire with his well-known recorder, that we owe success in telegraphy.

The first line of telegraph erected by Morse was in 1844, between Baltimore and Washington, which consisted of 40 miles of line and no wires.

Prof. Morse's invention consisted of a copper wire, insulated by means of a hempen strand, coated with tar pitch and India rubber. Morse could never have proved the utility of his invention if he had not had a patent to sell in shares to secure aid in introducing it.

The first patent for a printing telegraph was issued to Royal E. House in 1846, and this was the parent of a large class of inventions known as printing telegraphs, among which may be mentioned the Bain automatic telegraph, which was designed to avoid the Morse patent, and which resulted in a long litigation.

In April, 1868, Prof. Page obtained a patent, which was afterward, in 1871, reissued to his assignees, the Western Union Telegraph Company, in such broad terms as to include all telegraphic apparatus when a main circuit is caused to operate or control a local circuit, and also the use of a retractile spring to an armature of an electro-magnet. It consisted of a well-known form of induction apparatus, with an automatic circuit breaker, and was invented by Prof. Page many years before he took a patent, which was granted by special act of Congress, he being an employee in the Patent Office, and, therefore, disqualified by law to take an interest in any United States patent, except by inheritance or bequest.

In 1848 there were 2,000 miles of line and 3,000 miles of wire. In 1860 there were 17,582 miles of line and 26,375 miles of wire. In 1870, 53,403 miles of line and 107,245 miles of wire, and in 1880, 142,364 miles of line and 350,018 miles of wire.

These figures give some idea of the rapid progress of the telegraph in the United States.

In 1880 50,000,000 messages were sent, and the various companies employed 24,000 persons, and had 14,000 offices.

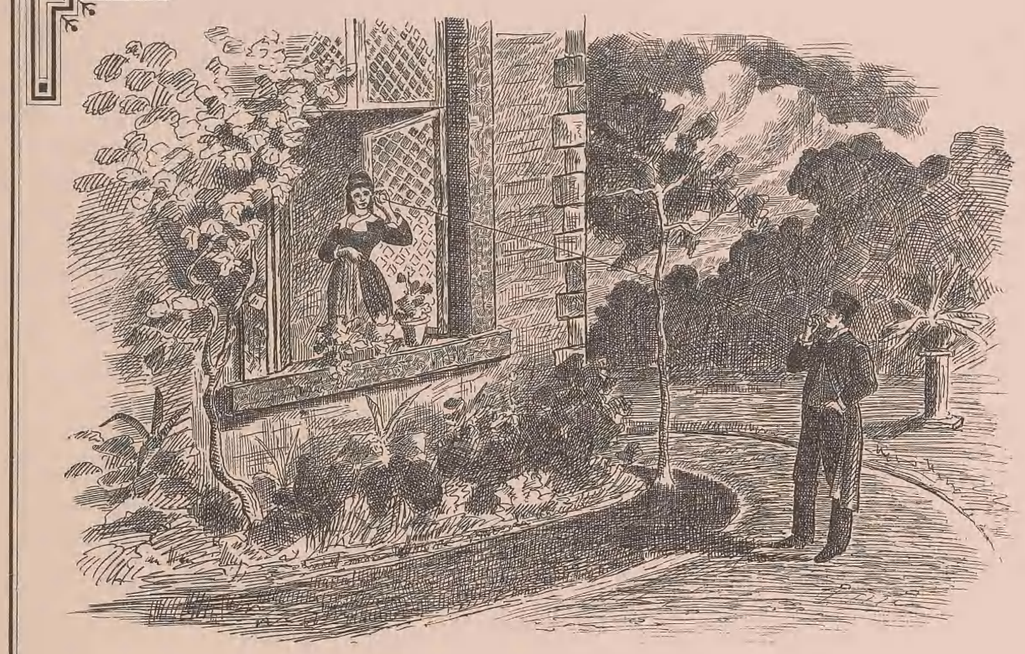
TELEGRAPHY.

1880

No. of Offices or Stations,	12,510
Miles of Line in Operation,	110,727
" Wire "	291,213
No. Messages Transmitted during the year,	31,703,181
" Hands Employed,	14,928
Wages Paid,	$4.886,128.00

1,006 Patents Granted by the United States.

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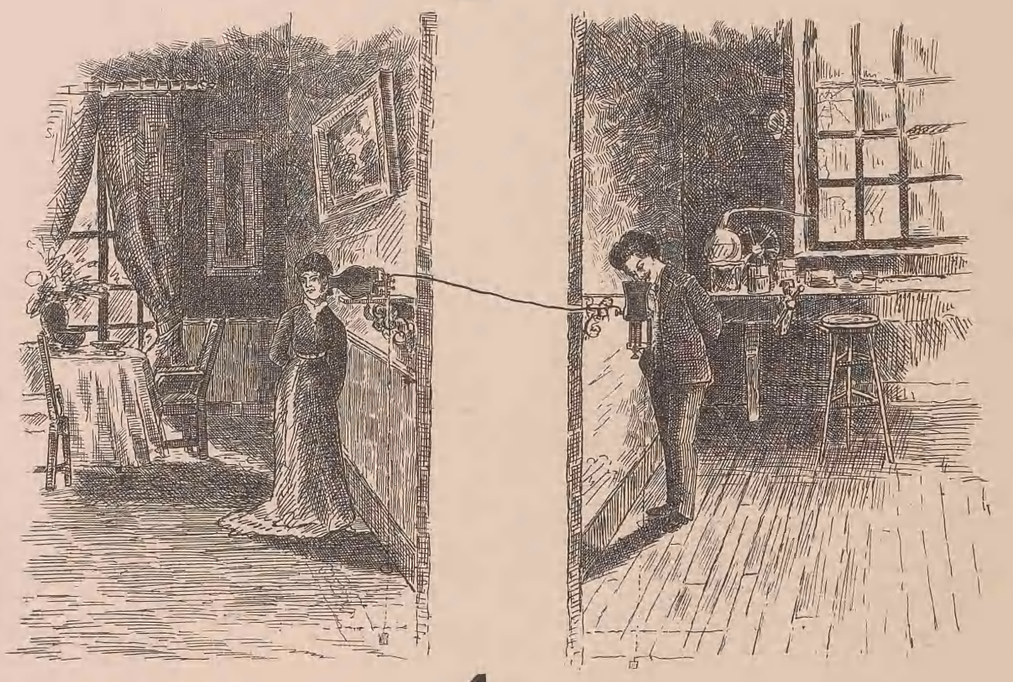
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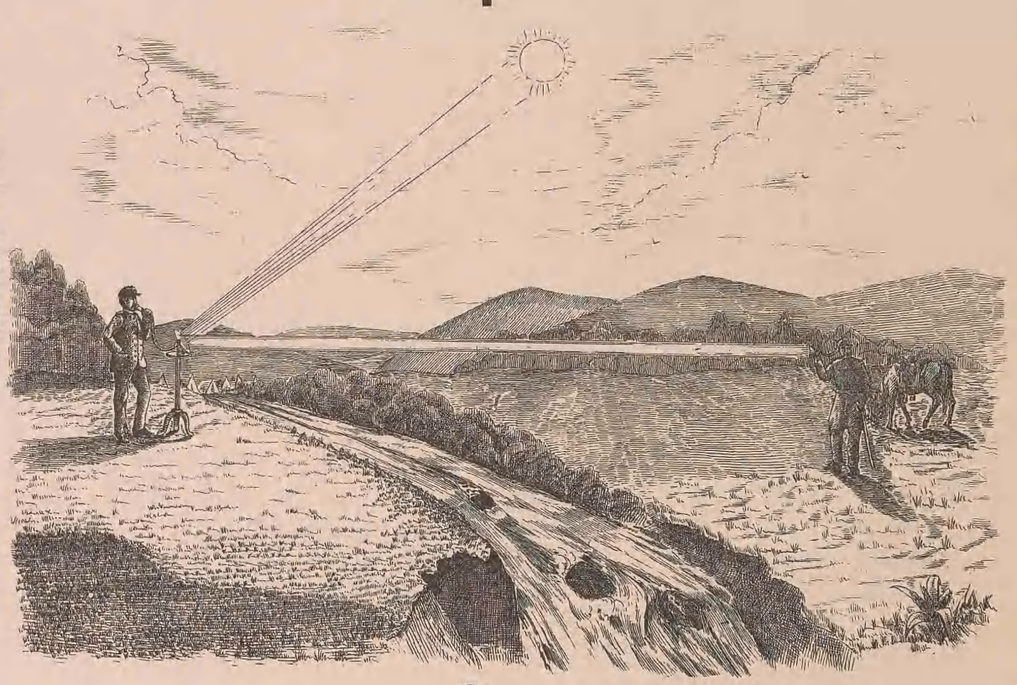
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TELEPHONES.

TELEPHONES.

No. 1. Primitive.
2. Musical.
3. U. S Patent, Magneto—A. D. 1876.
4. " " Electrical Contact—A. D. 1876.
5. " " Electrical Exchange System—A. D. 1879.
6. " " Radiophone—A. D. 1880.

This is from two Greek words—*teles*, far distant, and *phones*, sound.

The instruments by which articulate sound is now conveyed were invented by Alexander Graham Bell, of Boston, to whom a patent was granted March 7, 1876, for a speaking telephone. This gentleman had been studying the subject of conveying sound over an electric wire since 1867. His experiments were patiently conducted for nine years, often under discouraging circumstances; but he was rewarded in the end, and is one of the few inventors who has reaped large pecuniary returns from his invention.

The first public exhibition of the telephone was at the Centennial Exhibition in Philadelphia in July, 1876. The first lines for general use were erected in the early part of 1877.

The telephone was found to be incomplete without some means of calling the person at the other end of a distant line. Various kinds of call bells were tried and failed, and many inventions made before the magneto-bell, which is now in general use, was devised.

Patents were granted for transmitters to E. Berliner, Thomas A. Edison, and Francis Blake. All these were on the same general principle, but the Blake transmitter is the one generally used.

Single lines connecting two or three persons were soon found to be of limited value, and exchanges were organized, composed of subscribers, all of whom had lines running to a central office, so that any subscriber could communicate with any other subscriber to the exchange through the central office.

The first exchanges were started early in the year 1878, and at about the same time, in Chicago and New Haven.

Many inventions of great value have been made in switch boards and other machinery for the central office.

The telephone was early introduced into England and on the continent of Europe, and is now in use in every part of the civilized world.

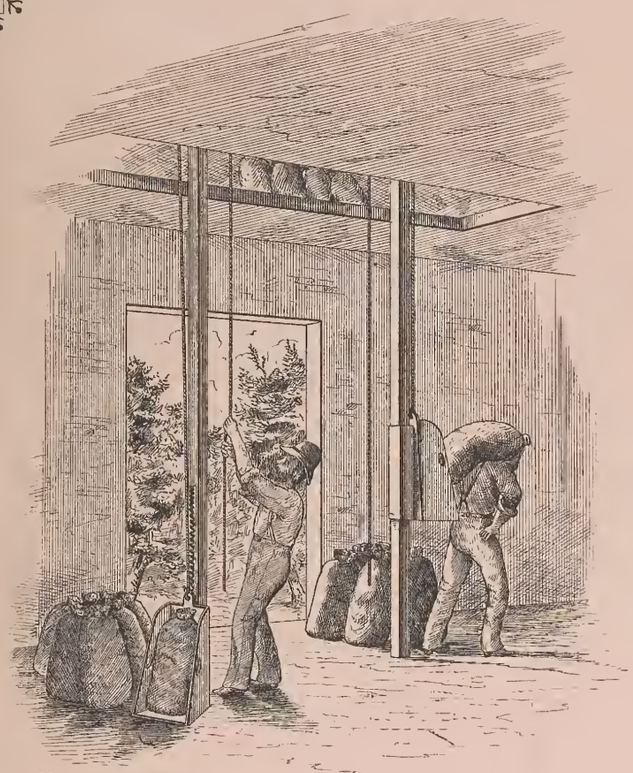
No invention was ever made which came into such general and universal use so rapidly as the telephone.

TELEPHONES.

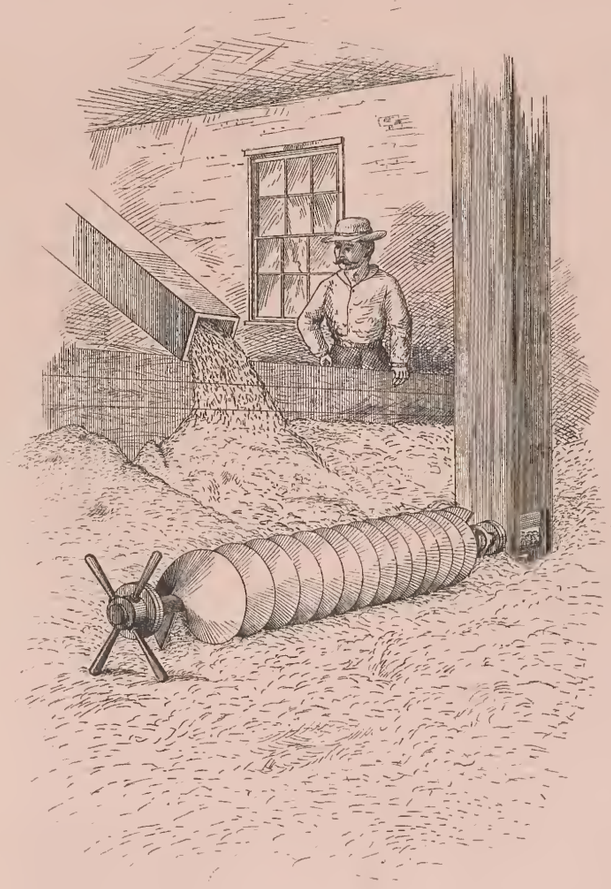
Number in use in the United States,	376,691
" Manufactured,	584,104
" Exported,	98,015
Total Number in Use,	477,344

1,472 Patents Granted by the United States.

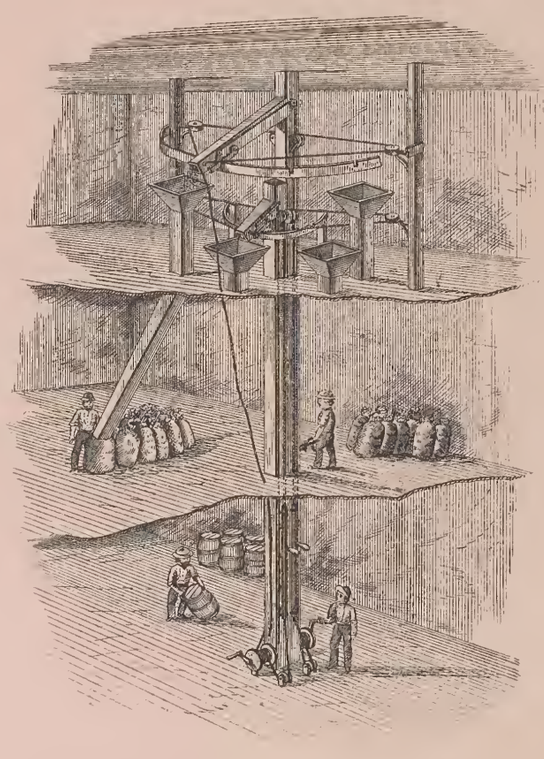
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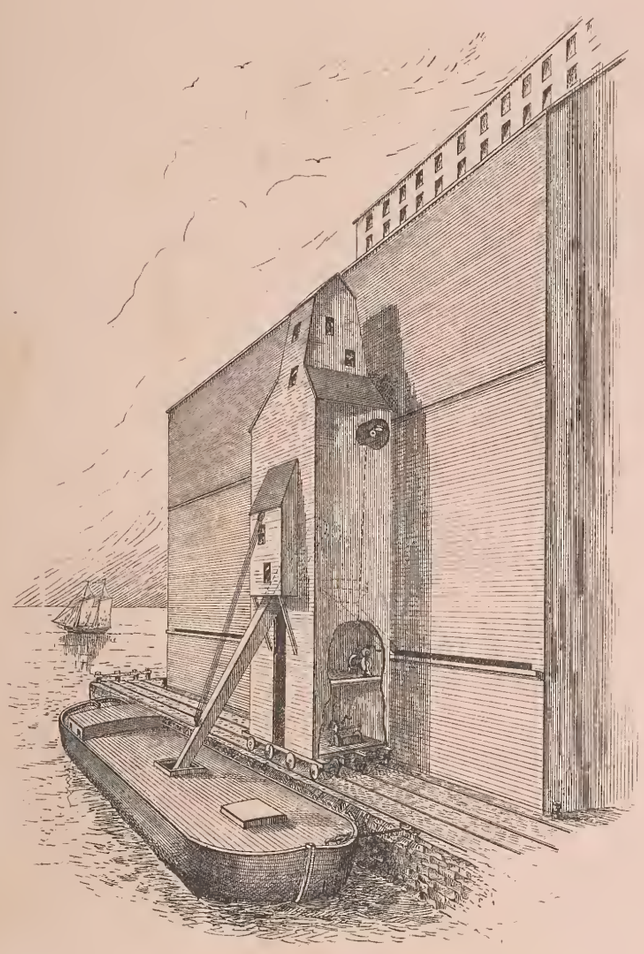
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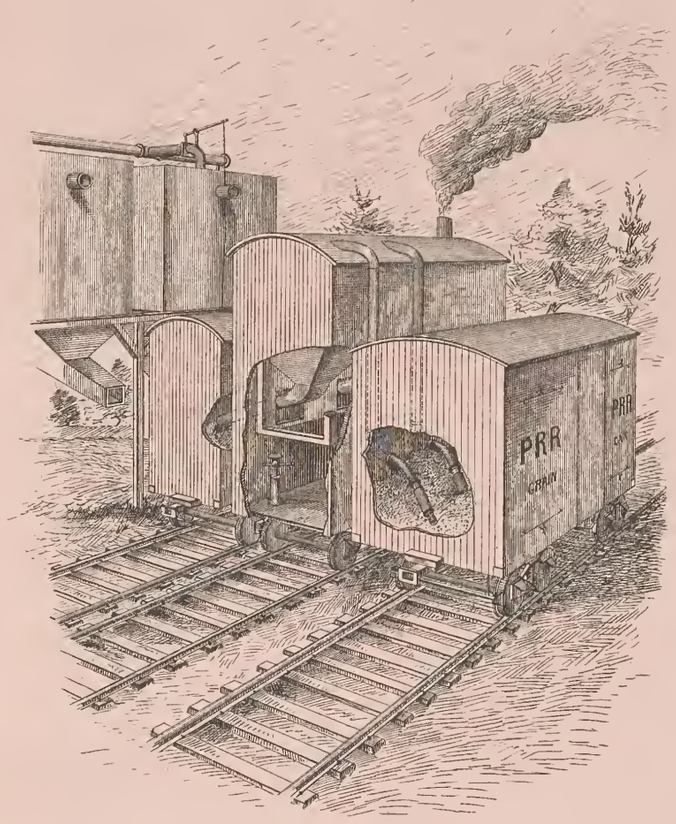
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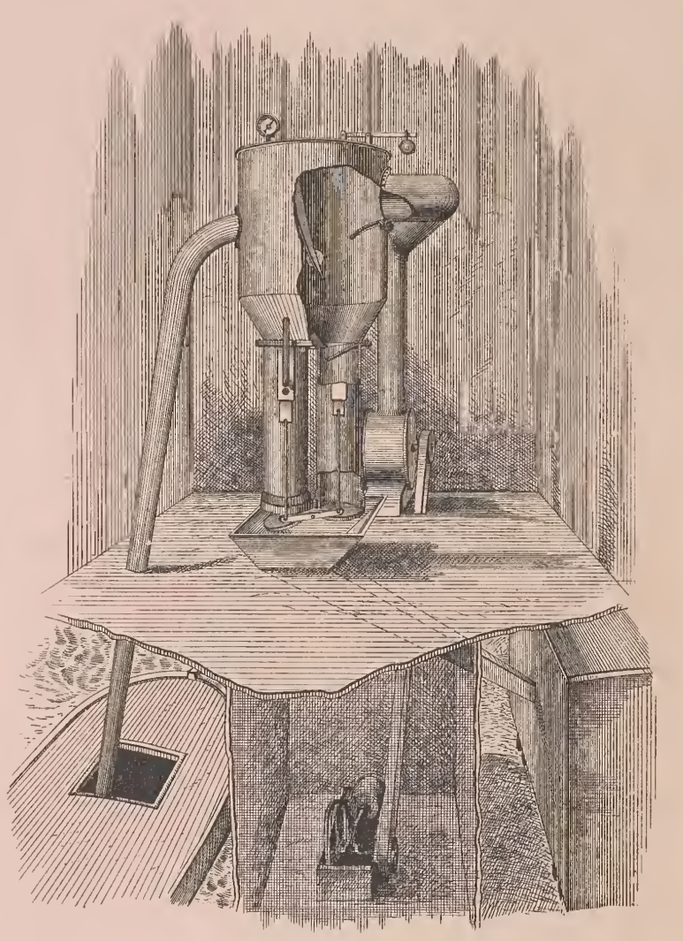
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GRAIN CONVEYORS.

GRAIN CONVEYORS.

No. 1. U. S. Patent, Elevator—A. D. 1834.
2. " " Screw—A. D. 1869.
3. " " Elevator—A. D. 1882.
4. " " Portable—A. D. 1882.
5. " " Pneumatic—A. D. 1883.
6. " " Transfer—A. D. 1883.

The first elevator, disconnected from milling, for transferring and storage of grain, was built by Joseph Dart of Buffalo, N. Y., U. S., in 1843.

There are many forms of grain conveyers, which generally agree in that they afford means of exposing a shower of grain to a current of highly dried and heated air. The following kinds may be cited, and it must be understood that there are many varieties and modifications of each.

In the conveyer system the grain from the spout passes consecutively through the cylinders, in each of which is a rotating screw conveyer driven by cog-wheels, having for axles hollow perforated tubes, through which the damp air passes from the grain, being drawn by the exhaust fan. The cylinders connect by the spout, and the lower one discharges by the spout. The heated air from the furnace rises into the chamber above and surrounds the cylinders.

In the revolving cup system, the grain enters upon a heated cone, and thence passes to a revolving flanged disk, which distributes it, to be again collected by the hopper, and fed to other disks, and so on, in descending series, to the discharge spout. A current of heated air ascends through the chamber and envelopes the grain at all times.

In the zigzag incline system, the grain descends from a hopper, and is shifted over from side to side by the alternate inclines, which are perforated plates in a flue occupied by an upward current of heated air.

The annular drum system consists of a vertical, double cylindrical chamber with conical ends. The space between the inner and outer casing is the one traversed by the grain, which enters at the apex of the upper, and departs at the apex of the lower cone. The inner and outer casings are all perforated with holes, about 2,300 to the square foot, the punching being from without, inward; the slight roughness has a tendency to turn the grain which rubs against the protuberances, giving a sort of stirring action thereto, and aiding the exposure of its whole surface to the stream of heated air. The heat is generated by a stove in the interior of the chamber, and the heated air passes through both casings and the body of grain contained between them. The apparatus stands on legs, so as to elevate the discharge opening, that the falling grain may be received into sacks for shipping.

The spiral flue system consists of a long spiral tube traversed by a flue from a stove. The sides of the tube are full of fine perforations, and the draft is upward between the two surfaces, and outward through the perforations, carrying the moisture from the grain, which descends in a shower between the flue pipe and the perforated casing.

The traveling belt system consists of a furnace, air box, and traveling belt, which receives its grain from a hopper. Grain from the hopper falls on a belt which travels over the grated top of the box, which is heated by air from a fan and tubes which form the box and basket grate of the furnace. After passing the length of the box the grain is caught between the belts and returned to the hopper for a repetition of the operation, or as it descends is intercepted by a spout.

In the rotatory drum system an inclined cylinder of wire contains the grain, which tumbles over and over, and is eventually discharged at the lower end of the cylinder, which rotates in a heated chamber.

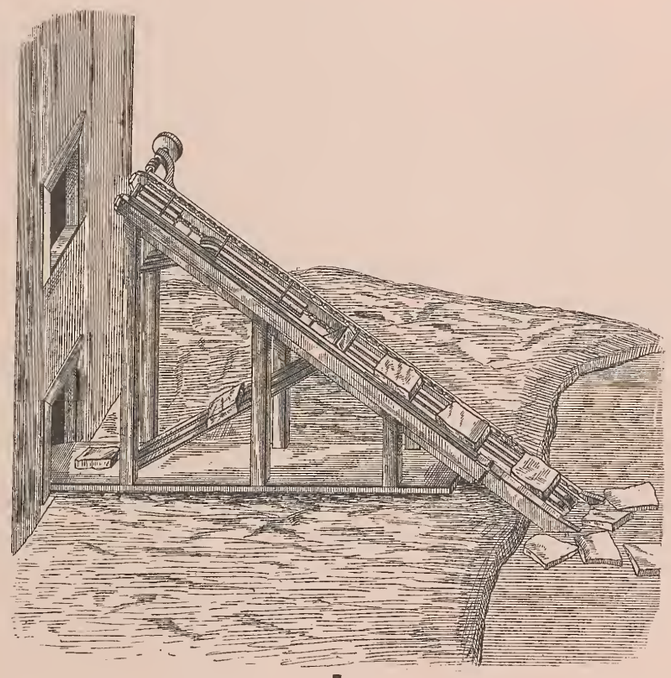
The largest grain elevator in the United States, and probably in the world, is situated in Brooklyn, New York. It has a storage capacity of 2,500,000, bushels, besides superior transfer facilities and dockage for half a dozen vessels, which can be loaded at one time. The machinery in the elevator can take grain at the rate of 8,000 bushels an hour from the barges or vessels at the pier. The grain is elevated, sifted and fanned, weighed, stored, put in bins, and then transferred to vessels at the pier. There are about five miles of belting, called conveyers. These conveyers travel at the rate of about 600 feet a minute, and carry to its destination $2\frac{1}{2}$ bushels of grain a minute.

GRAIN CONVEYORS.

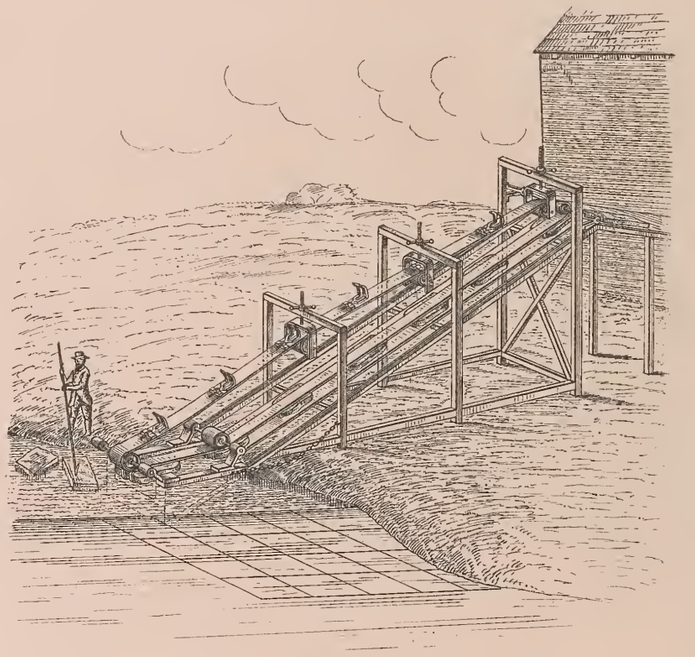
Capacity—	Primitive Mode.	Present Machines
Bushels per day,	1,000	80,000
Hands Employed per day,	10	10

184 Patents Granted by the United States.

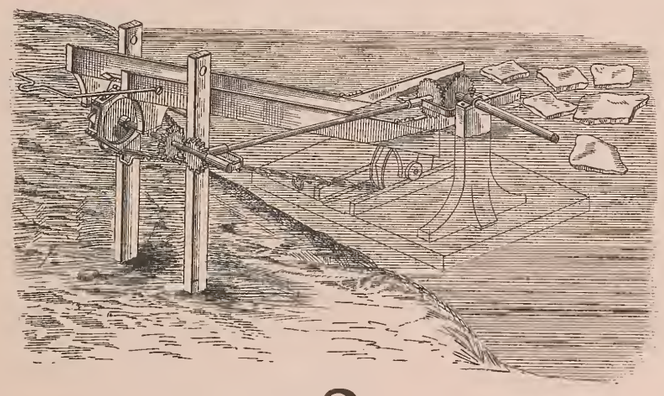
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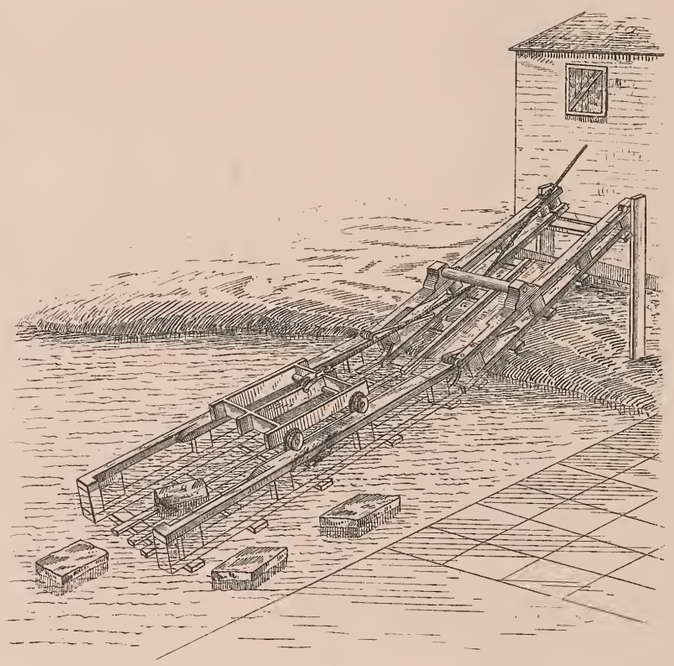
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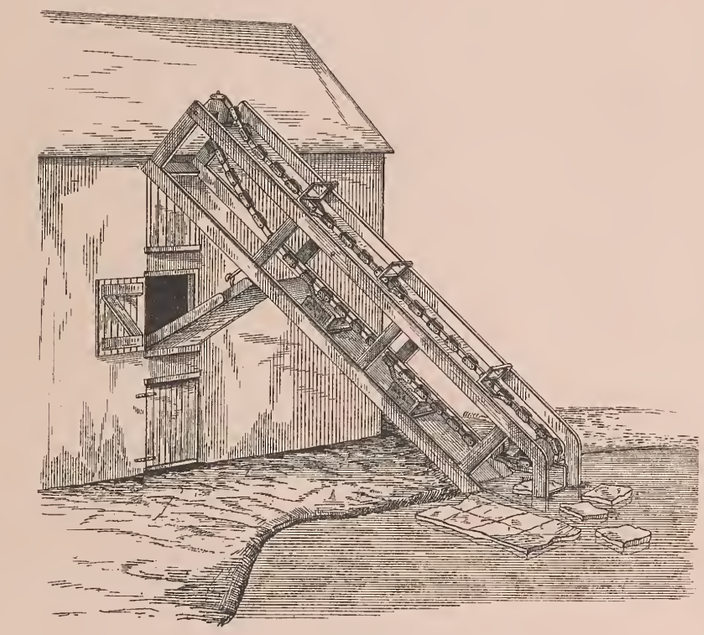
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ICE ELEVATORS.

ICE ELEVATORS.

No. 1. U. S. Patent, Ice Elevator—A. D. 1858.
2. " " Inclined Track—A. D. 1872.
3. " " Elevating Chain—A. D. 1874.
4. " " Inclined Track—A. D. 1876.
5. " " Endless Chain—A. D. 1880.
6. " " Horse Power—A. D. 1884.

The methods of gathering and storing ice are entirely of American origin. In the year 1805 the first cargo of ice was shipped from Boston, Mass., to the Island of Martinique.

Mr. Tudor, of Boston, Mass., first conceived the idea of collecting and preserving ice for human consumption. Beginning in the smallest manner, in the winter of 1805, he gathered ice from Fresh Pond, a lake near Cambridge, Mass., improving the necessary implements for handling, &c. In 1820 he shipped a cargo of ice to New Orleans, La., and the story is current that, the cargo arriving during the prevalence of yellow fever, so alarmed the population, who were ignorant of the precise purpose and character of the shipment, that a riot ensued, during which the entire cargo was destroyed. Subsequent shipments, however, made known the value of ice in that city, where it has commanded, at different seasons, according to the supply, from $15 to $100 per ton.

The present manner of gathering ice is as follows:

When the ice becomes 8 or 10 inches thick the cutting is begun.

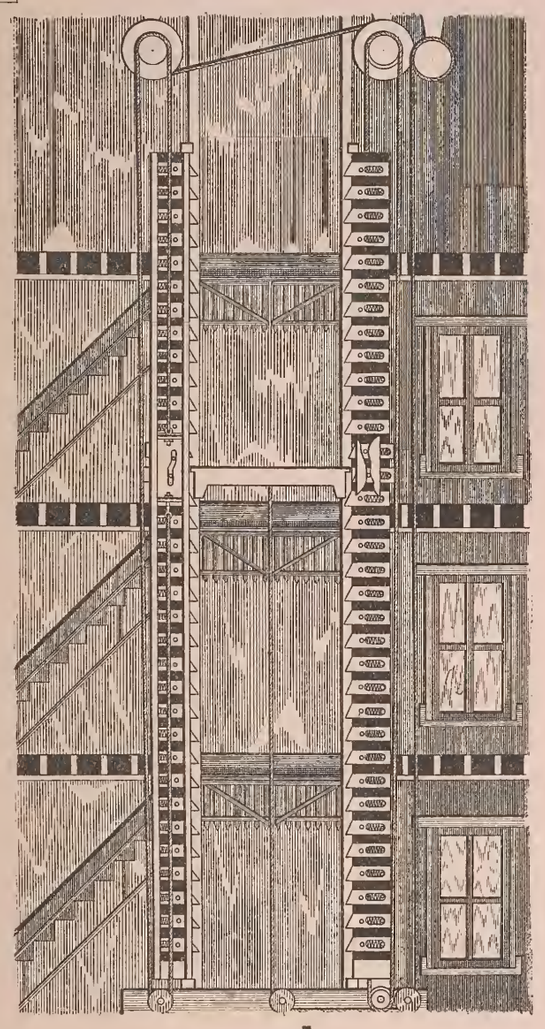
A "marker" drawn by a horse is then run across the pond or river, one side having sharp cutting irons, the other simple guide bars that run in grooves made by the cutters at the previous cut. These grooves are then intersected at right angles in the same way 22 x 36 inches, and about an inch deep. Then follows the ice plow, having a deeper blade with a series of chisel points, which sinks the groove to a depth of from 3 to 5 inches, depending upon the thickness of the ice. Then a gang of men, with heavy chisel bars, bar off rafts of these blocks in such shape as to admit their passage through a canal which has previously been cut from the house to the pond, and through which the ice is either towed by horses or pushed along by men with long pike poles to the hoisting aprons at the dock. Reaching the apron, the ice is in solid blocks; these are caught by a series of buckets or cleats, which are secured to an endless chain, which is moved over an incline run by steam power. Thus the ice ascends this incline in a continuous stream, whence it is run on galleries, and then is slid into the various rooms by its own gravity on descending runs.

The endless chain elevators are of modern invention, and they have entirely revolutionized the process of housing ice. Six hundred tons of ice have been taken out and stored in an ice house in one hour by means of the inclined plane elevators, operated by steam power.

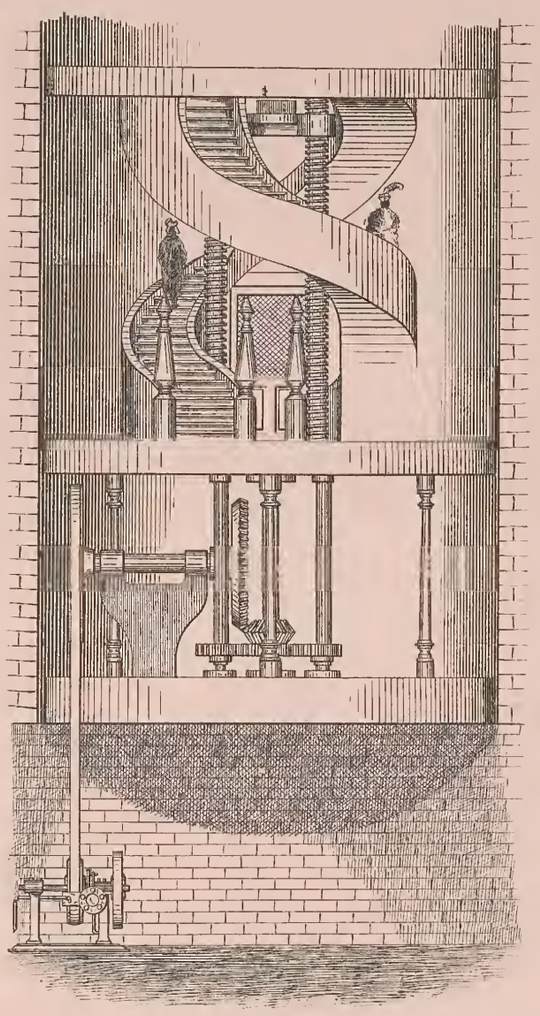
ICE ELEVATORS.

56, Patents Granted by the United States.

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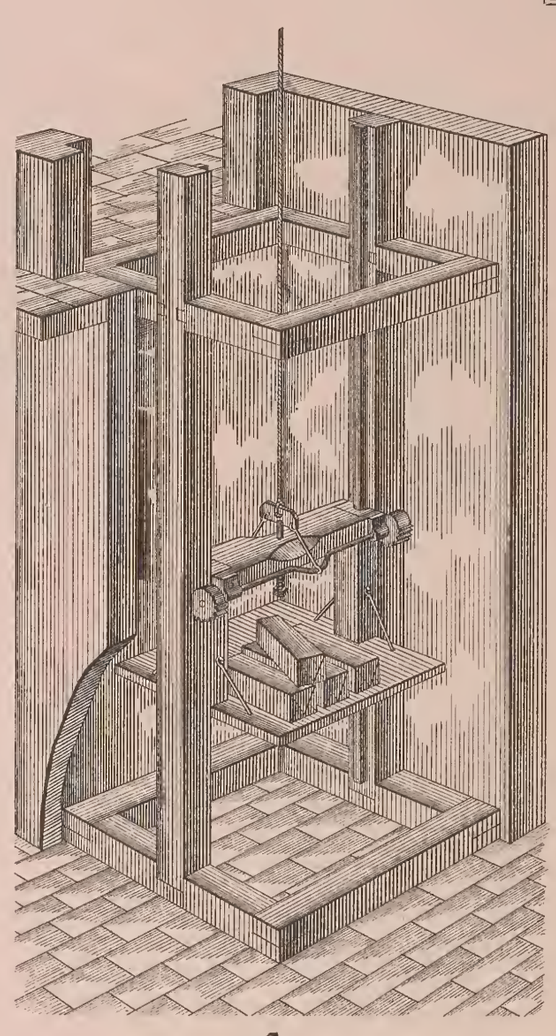
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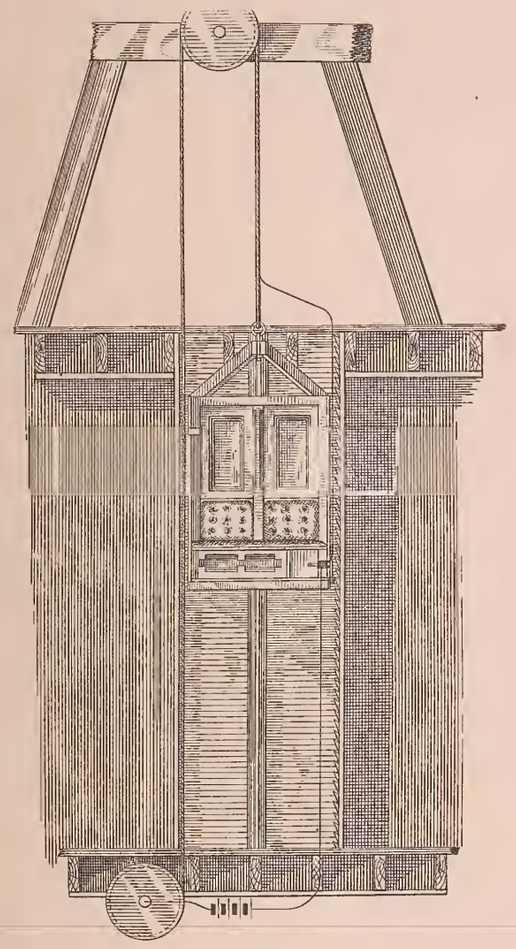
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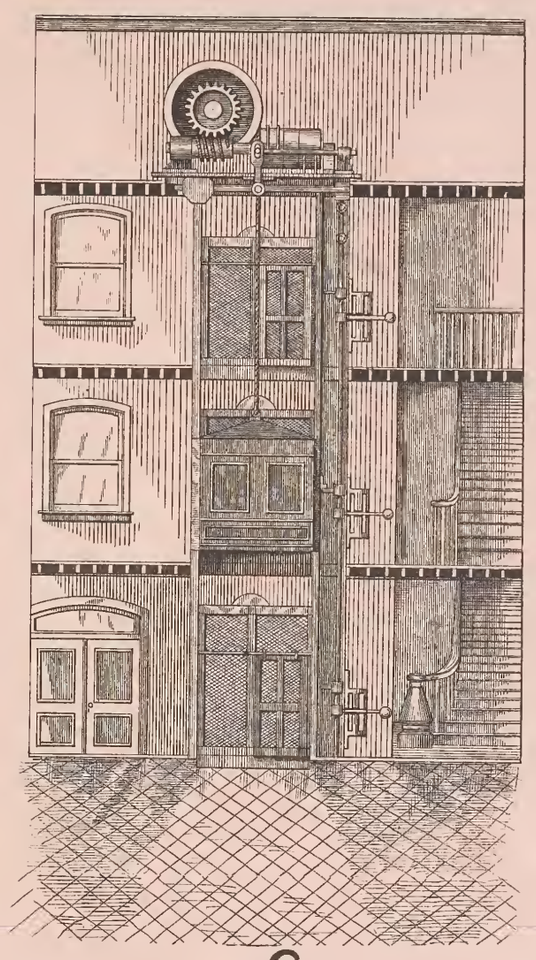
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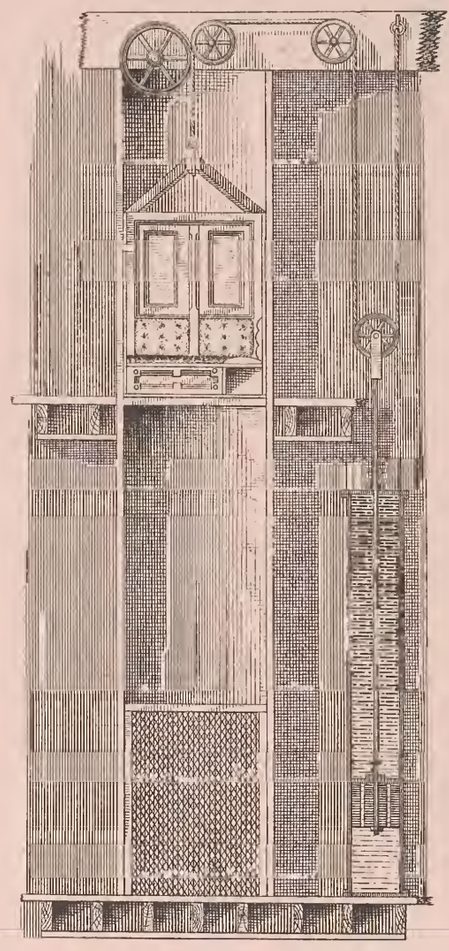
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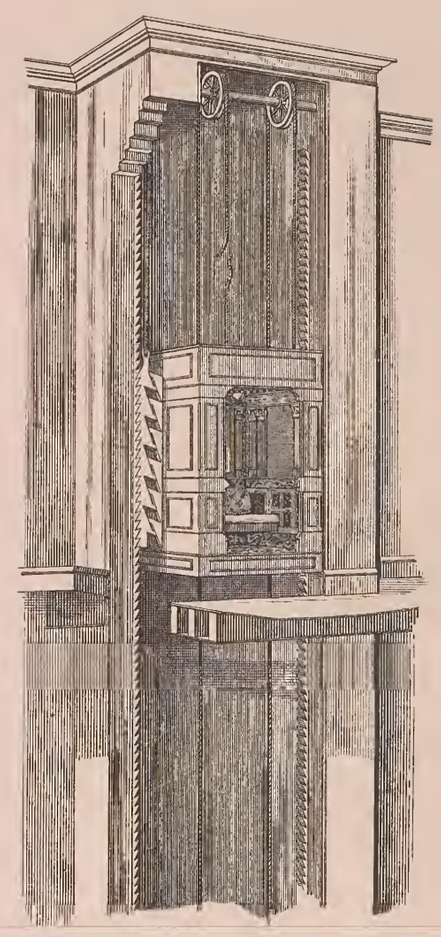
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8

PASSENGER AND FREIGHT ELEVATORS.

PASSENGER AND FREIGHT ELEVATORS.

No. 1. U. S. Patent, Safety Catch—A. D. 1876.
2. " " Twine Stair—A. D. 1876.
3. " " Freight—A. D. 1879.
4. " " " —A. D. 1880.
5. " " Electric Safety Stop—A. D. 1882.
6. " " Automatic Stop—A. D. 1883.
7. " " Safety Appliance—A. D. 1883.
8. " " Hydraulic—A. D. 1884.

A primitive hoisting machine is used in the Convent of St. Catherine, at the foot of Mount Sinai, to raise travellers to a door in the second story.

A form of elevator used in mines is called the "man engine."

At the Trevesan mine, in Cornwall, England, a man engine has been constructed for lifting the miners and lowering them to their work, a depth of 240 fathoms.

The St. Louis Union Depot Elevator Co. uses a rubber belt 260 feet long, 48 inches wide; weight, 2,390 pounds.

Without the elevator we would have been deprived of the most striking structures of New York City; for instance, the Equitable, Mutual Life, Wells, Western Union, Potter, Morse, Field and Tribune buildings.

PASSENGER AND FREIGHT ELEVATORS.

CAPACITY—	Primitive Mode.	Present Machine.
Pounds raised 550 feet, . .	500	10,000
Hands Employed per day, . .	1	1

732 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



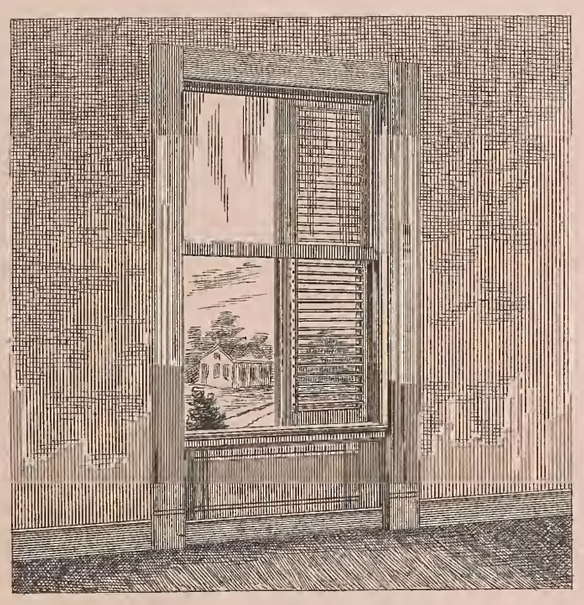
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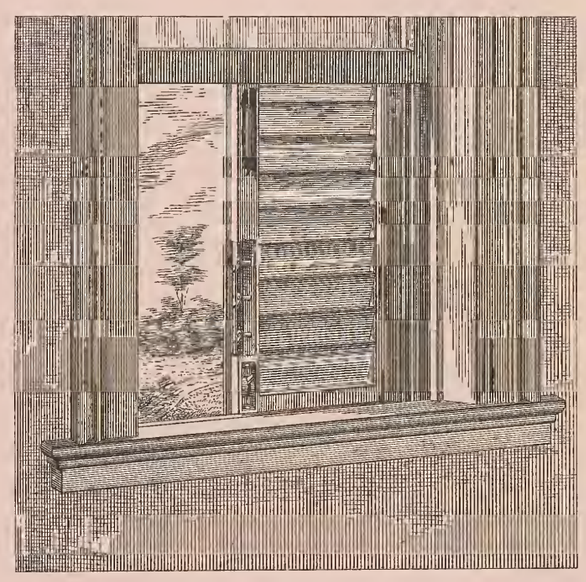
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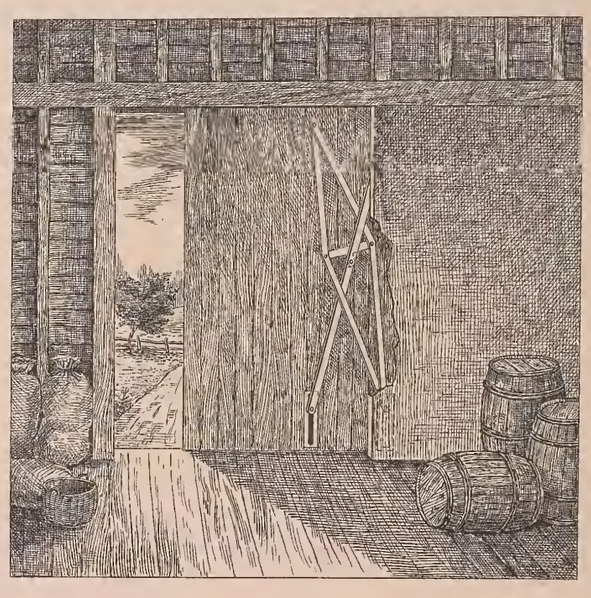
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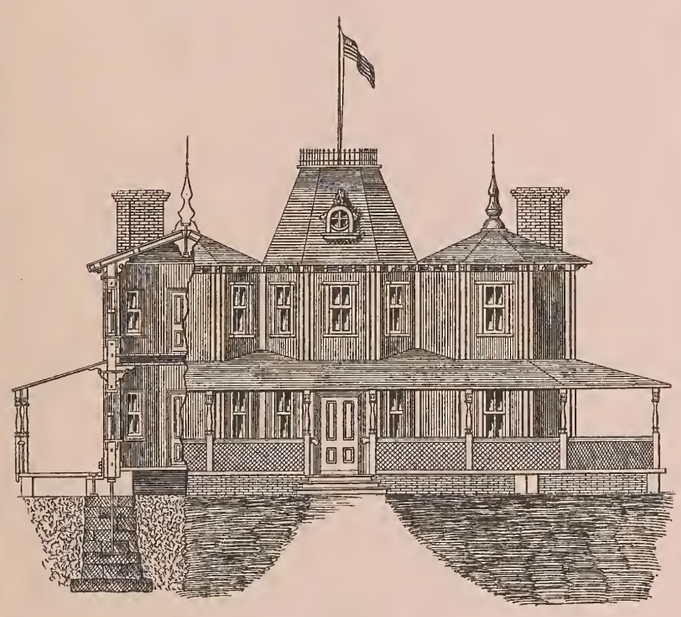
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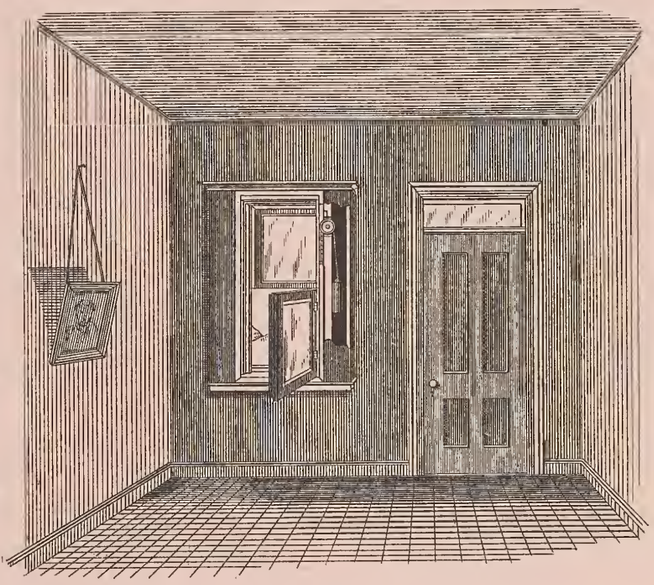
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ARCHITECTURE.

ARCHITECTURE.

No. 1. Aboriginal Dwelling.
2. Primitive Door and Window.
3. Emigrant Cabin. Window.
4. U. S. Patent, Rolling Slat Shutter—A. D. 1835.
5. " " " " " —A. D. 1878.
6. " " Sliding Door—A. D. 1878.
7. " " Portable House—A. D. 1879.
8. " " Removable Window Sash—A. D. 1883.
9. Modern Villa.

Architecture is the art of inventing and drawing designs for buildings, or the science which teaches the method of constructing any edifice for use or ornament. It is divided into civil, military and naval.

Civil architecture was among the earliest inventions, and its works have been commonly regulated by some principles of hereditary imitation. Whatever rude structures the climate and materials of any country have obliged its early inhabitants to adopt for their temporary shelter have, with all their prominent features, been afterwards, in some measure, kept in view by their refined and opulent posterity.

The ancient colossal ruins abounding in Siam, Japan, the islands of the Indian Ocean, and the wonderful tombs, temples, and pyramids of Egypt proclaim the early knowledge of architecture.

To Greece we are indebted for the invention of the three principal orders—the Doric, Ionic and Corinthian—Rome added the Tuscan and the Composite. Each of these orders has a particular expression, so that a building may be solid, neat, delicate or gay, according as the Tuscan, the Doric, the Ionic, the Corinthian or the Composite is employed.

The columns of the several orders are easily distinguishable by the ornaments that are peculiar to their capitals.

After the destruction of the Roman Empire the classic architecture of Greece and Rome was lost, but was revived by the Italians at the time of the restoration of letters. All the debased styles which sprang from vain attempts to imitate the ancients, and which flourished from the destruction of the Roman Empire till the introduction of the Gothic, have been united under one term, the Romanesque. The origin of the Gothic style is a matter of great uncertainty. The Saxon and Norman styles were so called because they were respectively used by the Saxons in England before the conquest, and by the Normans after it, in building their churches.

The Saxon and Norman continued to be the prevailing modes of building in England until the reign of Henry the Second, when the modern Gothic, or pointed style, was introduced.

In the fifteenth and sixteenth centuries Greek and Roman architecture were revived and brought the five classic orders again in use.

The following are the dates of the erection of a few celebrated edifices:

Pyramids, B. C. 1500; Solomon's Temple, B. C. 1004; Jupiter Capitolus, B. C. 616; Parthenon, B. C. 438; Pantheon, A. D. 13; Coliseum, A. D. 70; St. Sophia, A. D. 532; Mosque of Omar, A. D. 637; St. Peter's, Rome, A. D. 1616; St. Paul's, London, A. D. 1710.

The Gothic order gained ascendency in England in 1840, when it was adopted for the new houses of parliament.

The Bartholdi Statue of Liberty is in principle a duplicate of the Colossus of Rhodes. It is erected on Bedloe's Island, New York Harbor. The total height is 328 feet and 11 inches; the statue proper is 151 feet 2 inches.

The Washington Monument is the highest structure in the world, being 555 feet high.

ARCHITECTURE.

9,184 Establishments in the United States.

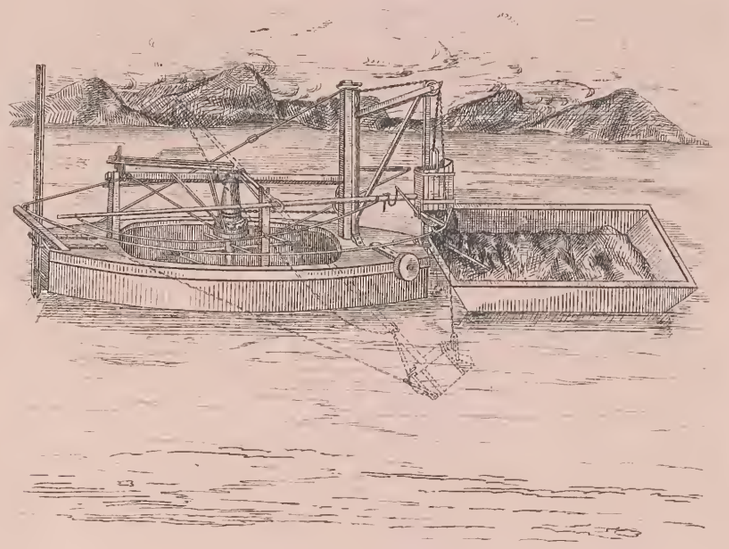
	1860	1880
Capital Invested,	$3,251,357.00	$19,441,358.00
Value of Productions,	12,646,392.00	94,152,139.00
Wages Paid,	3,868,672.00	24,582,077.00
Hands Employed,	9,006	54,138

1,261 Patents Granted by the United States.

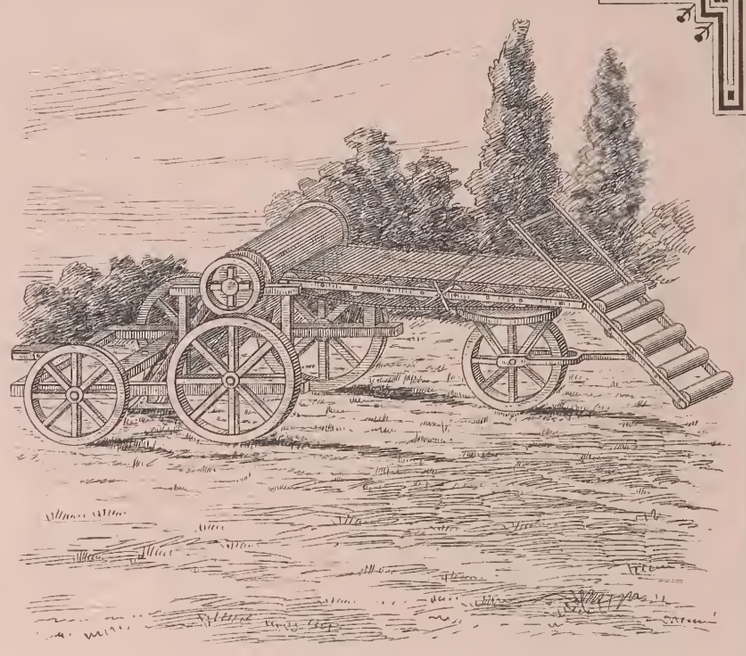
Sackett & Wilhelms Litho Co New York



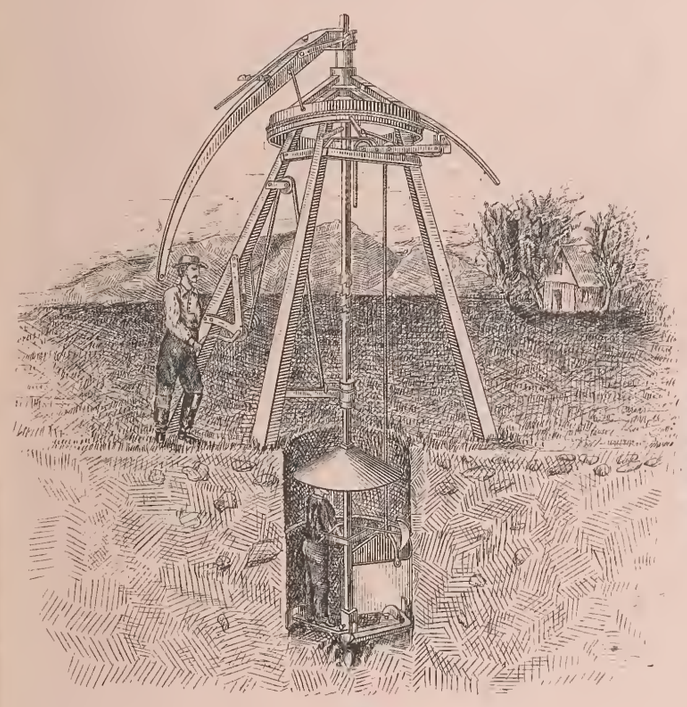
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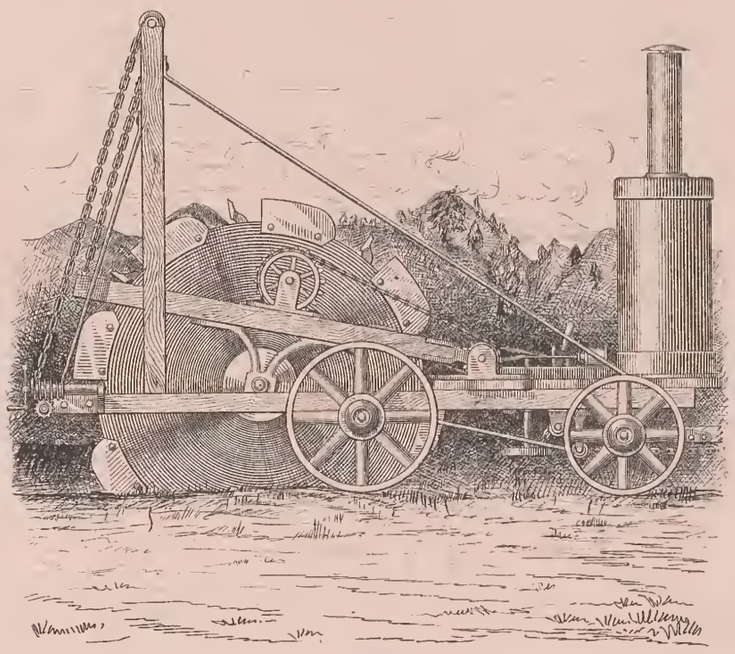
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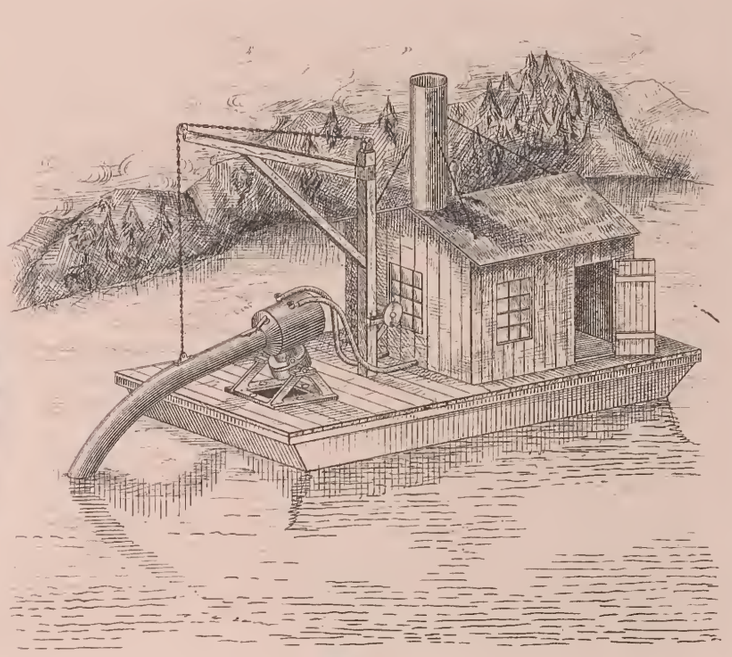
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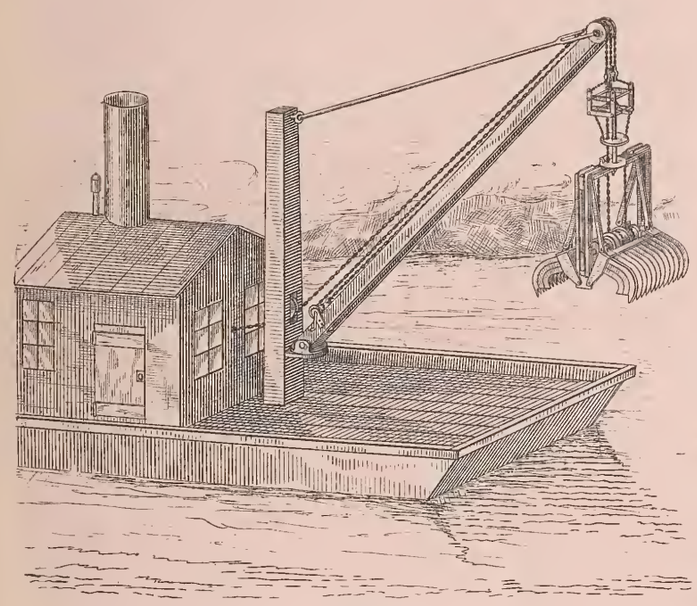
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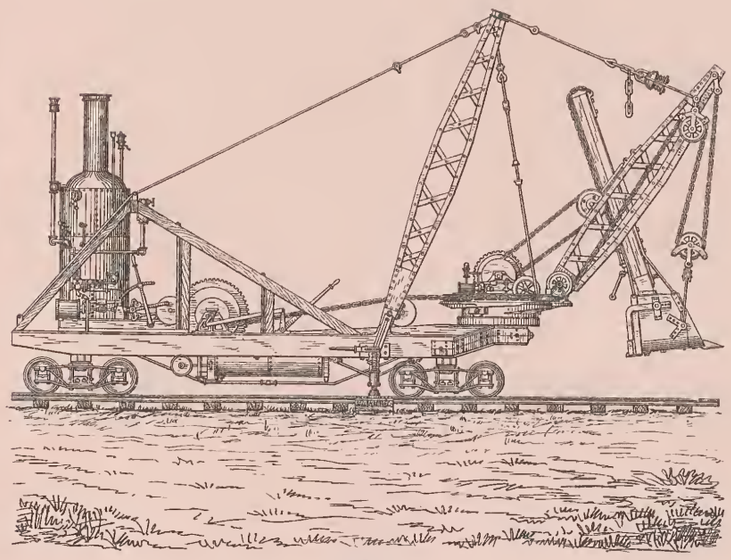
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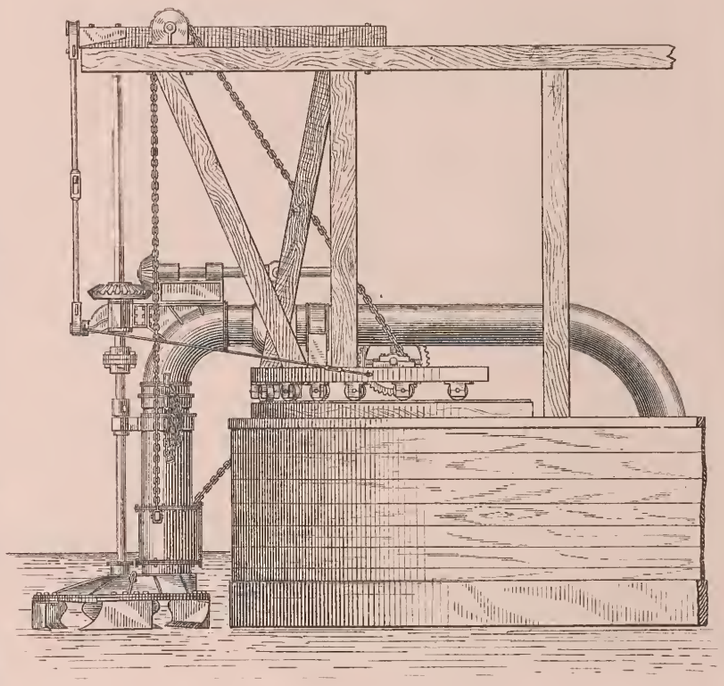
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9

EXCAVATORS.

EXCAVATORS.

No. 1. Primitive.
2. U. S. Patent, Dredger—A. D. 1830.
3. " " Excavator and Carrier—A. D. 1838.
4. " " Well Borer—A. D. 1878.
5. " " Tile Ditcher—A. D. 1881.
6. " " Steam Vacuum Dredger—A. D. 1881.
7. " " Clam Shell Dredger—A. D. 1884.
8. " " Steam Navvy—A. D. 1884.
9. " " Pumping Dredger—A. D. 1884.

Excavating machines are of modern invention. In the reign of Charles I, Balme made a machine consisting of a vertical wheel with six buckets, which was worked between boats in raising mud; it was employed in the Fens of Lincolnshire.

About 1708 Savery patented a steam dredger for raising ballast from the Thames.

In 1796 Watt constructed a steam dredger for deepening Sunderland Harbor.

The chapelet used by French engineers in the last century for deepening channels, removing mud from the interiors of coffer dams, and preparing foundations for bridges, was composed of three rollers, two of which touched the ground and the other was placed upon an elevated scaffold, where the mud and silt were deposited; around these rollers worked an endless chain formed of large links, to which were attached four or more iron scoops, which were placed at regular distances; these scoops were pierced with holes and had strong projecting beaks which dug into the mud or earth below.

The excavated earth along some parts of the Suez Canal was transported by means of pumps. By the aid of a steam pump water was mixed with the earth brought up by the dredge, and the mud so formed was spouted out upon the banks to such a distance, and in such quantities, as to form high, compact ramparts against sand showers blowing in from the desert.

Ninety-six million cubic yards of earth were taken out, making a canal ninety miles long, three hundred and twenty-eight feet wide at the surface, seventy-four feet wide at the bottom, and twenty-six feet deep. Sixty dredging machines were at work at one time on this canal.

The steam dredger commonly in use has a succession of buckets on an endless chain, which traverse on a frame whose lower end is vertically adjustable so as to regulate the depth to which it works. This class of machines was first successfully used in England, and after repeated trials raised two thousand tons per day from an average depth of thirty feet.

The Willard excavator has been widely used in the United States in making railway embankments, and in forming the beds for ballast and sleepers. With this machine the earth is scooped up by the shovel, carried between the wheel and the traveling apron, and dropped into a hopper; when this is full the machine is drawn to the site and the load dumped.

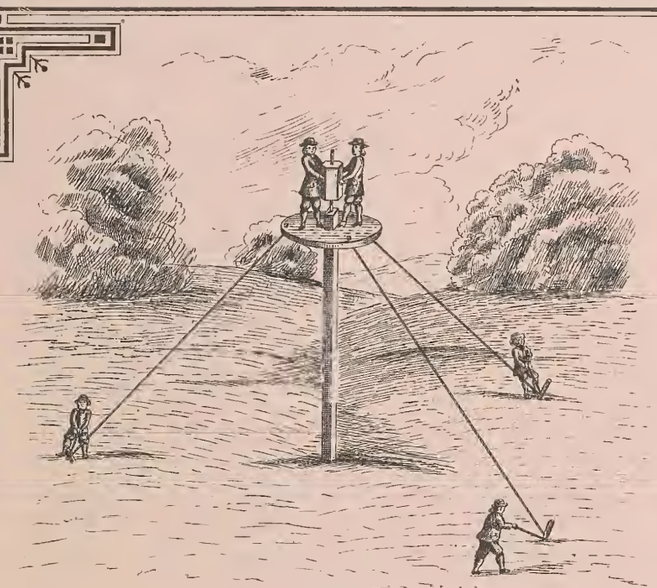
The Northern Pacific Railroad has an excavator capable of handling 1,000 to 1,500 yards of earth per day.

The largest excavator in the world is in England. It was tried on the Clyde; dredged at the rate of 400 tons per hour, and loaded a steamer with several hundred tons per hour. It dredged from five to thirty-five feet depth.

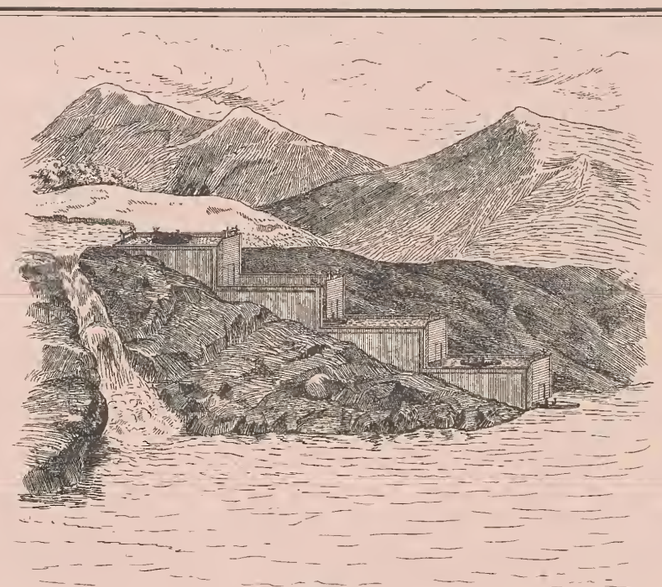
EXCAVATORS.

1,027 Patents Granted by the United States.

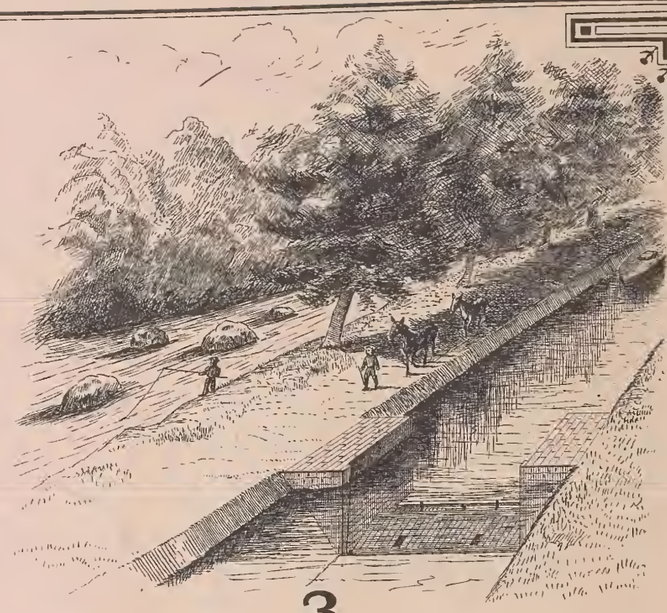
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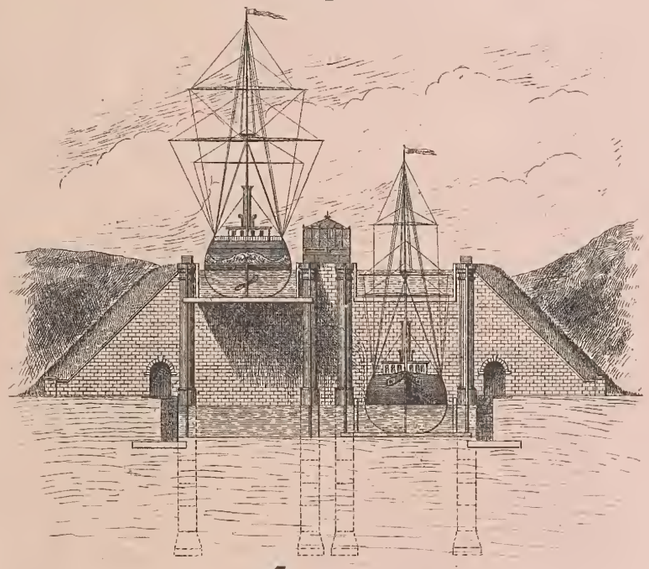
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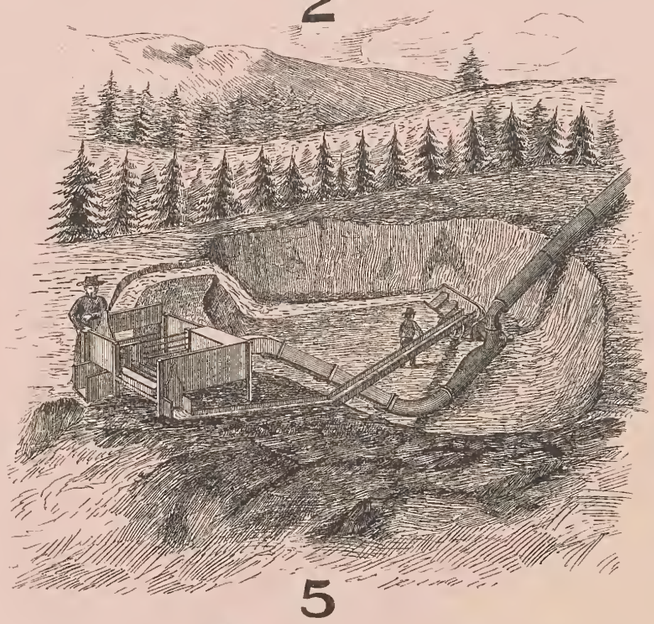
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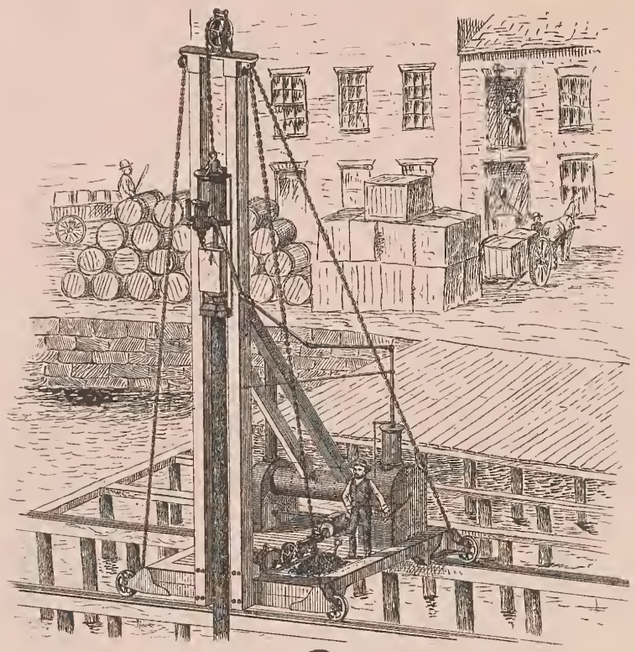
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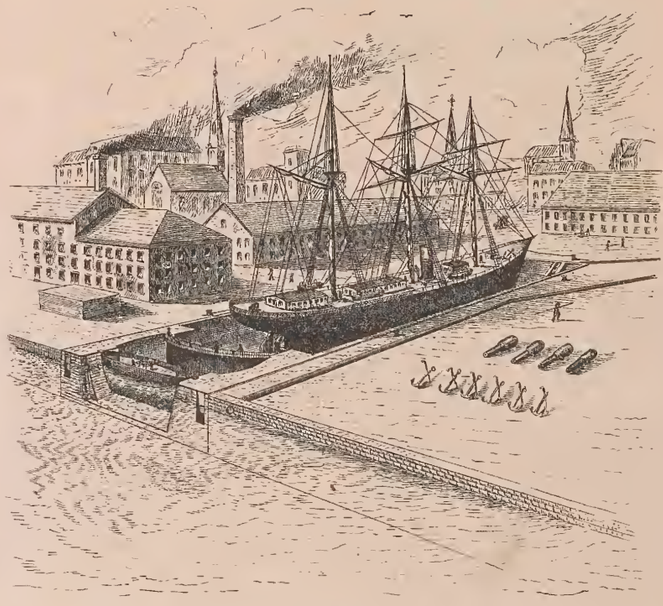
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HYDRAULIC ENGINEERING.

The Phoenicians, who were the earliest tribes on record, more than 1200 B. C. settled upon the coasts of the Mediterranean, built Sidon, Tyre and other coast towns, and formed moles and harbors for the protection of their shipping.

The defence and siege of Tyre, 332 B. C., furnished other interesting records of early engineering.

When we turn to Ancient Egypt we are again met with most remarkable remains of early engineering skill. One of their monarchs, Menes, actually diverted the course of the Nile, and, by cutting water courses and raising embankments, converted the immense marsh, which existed upon both sides of the river, into the finest agricultural district in the world.

The city of Rhodes owed its beauty to Hippodamus, a celebrated Greek engineer.

Philon and Callicrates were Greek engineers, who lived about 400 B. C.

According to Herodotus, Necas attempted to open a communication between the Nile and the Red Sea by means of a canal, but was prevented from completing it by the advice of the Oracle, after having lost 120,000 men in the enterprise. It was resumed and carried on by Darius, son of Hystappas, who relinquished the undertaking on representation being made to him by unskillful engineers that the Red Sea, being higher than the land of Egypt, would overwhelm and drown the whole country. Ptolemy Philadelphus, however, finished the undertaking and constructed in the most convenient part of the canal a dam, or sluice, ingeniously contrived, which could be opened to give passage to the water as occasion might require, and is, therefore, the origin of modern locks to canals.

This mode of inland navigation was introduced into England by the Romans, who constructed a canal from the river Nyne to the river William, three miles south of Lincoln.

For a period of 440 years the Romans contented themselves with the waters of the Tiber and the wells and fountains in the city, but when the number of houses and inhabitants was augmented they were obliged to bring water from remote places by means of aqueducts. This was effected by Appius Claudius in 442. Some of these aqueducts were paved, and others conveyed the water through a natural channel of clay. Water was also conducted by pipes of lead into reservoirs of the same metal, or into troughs of hewn stone.

Frontinus, who had the direction of the aqueducts under the Emperor Nerva, mentions nine aqueducts which emptied themselves through 13,594 pipes an inch in diameter.

Modern engineers have followed the plan adopted by the Romans, of forming breakwaters by the immersion of large blocks of stone or concrete, piling them up without regard to order until they appeared above the water.

In the spring of 1776 New York was supplied with water conveyed through pipes in the streets; a reservoir was constructed on the east side of Broadway, near Pearl street, into which water was raised by pumping from wells sunk on the premises.

The principal docks in England are the East and West India, the London, the St. Katherine, Commercial and Victoria.

In the United States are to be found the finest docks in the world. The largest is the Granite dock at the Brooklyn Navy Yard. There are also numerous floating docks at New York City, the principal of which are the balance docks, the floating sectional and the hydraulic screw docks, besides the dry docks.

New York possesses several basins called the Atlantic and the Erie, situated in Brooklyn City. The Erie basin is said to be the largest in the world.

The Imperial Canal, of China, is over 1,000 miles long.

In the year 1681 was completed one of the greatest undertakings of the kind in Europe, viz., the Canal of Languedoc, to connect the Atlantic with the Mediterranean; its length is 148 miles.

The largest ship canal in Holland is the Great Northern, completed in 1825, which extends 51 miles. The Suez is a little short of 100 miles in length.

The longest canal in the United States is the Erie, of New York, viz., 350¼ miles.

Artificial basins with locks, enabling ships to lie afloat while loading or unloading, were first constructed in Liverpool, England, in the commencement of the eighteenth century.

The earliest dam builders were the beavers; their dams, in districts long since deserted by them, remain as monuments of their wonderful sagacity.

Probably the largest dam in the United States is that completed in 1849 at South Hadley Falls, Mass.; it is 1,007 feet long, and 28 to 32 feet high. The structure consumed about 4,000,000 feet of lumber.

Probably the highest ever constructed is in the province of Alicante, Spain; its height is 156¼ feet; it was built in the year 1594.

The operative power in hydraulic mining is derived from a reservoir of water placed at a high elevation above the point of action, whence the water is conveyed through a hose and projected with terrific force, under a pressure of from 80 to 200 feet, against the dirt above the bed rock. The effect is equal to the combined labor of several hundred men; the force exerted being literally equivalent to the removal of mountains, as the superincumbent masses of earth and rock frequently come tumbling down in quantities of hundreds of tons at a time. The dirt thus loosened is conveyed into and washed down the sluice.

To fortify the hose to withstand the fearful pressure of the water, it should be stoutly banded with strong galvanized iron rings, about 2 inches broad, secured around the hose at intervals of about 2 inches apart.

The quantity of water required by a hydraulic claim varies from 50 to 300 inches.

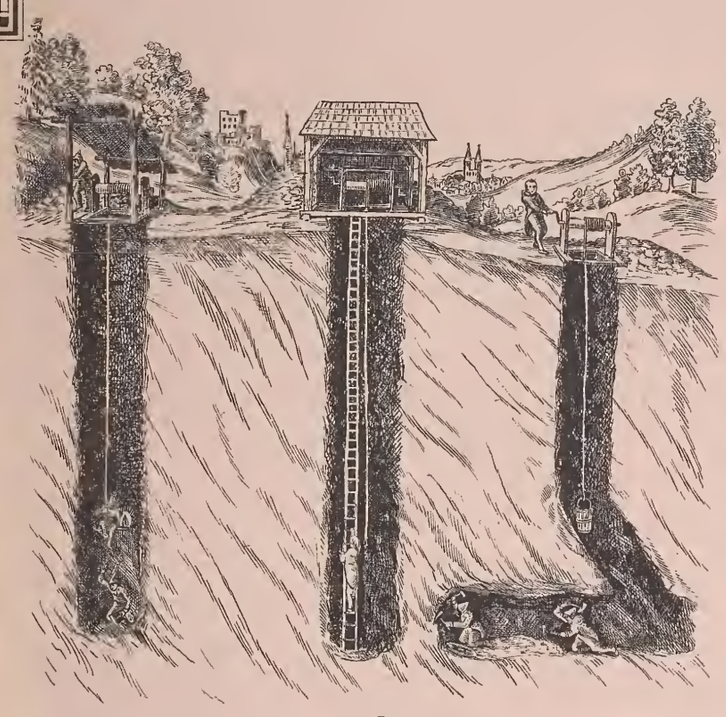
HYDRAULIC ENGINEERING.

No. 1. Primitive Pile Driver—A. D. 1725.
2. " Canal Lock—A. D. 1725.
3. U. S. Patent, Canal Gate—A. D. 1827.
4. " " Hydraulic Lock—A. D. 1874.
5. " " " Mining—A. D. 1878.
6. " " " " —A. D. 1879.
7. " " Ship Railway—A. D. 1881.
8. " " Steam Pile Driver—A. D. 1883.
9. " " Standard U. S. Dry Dock.

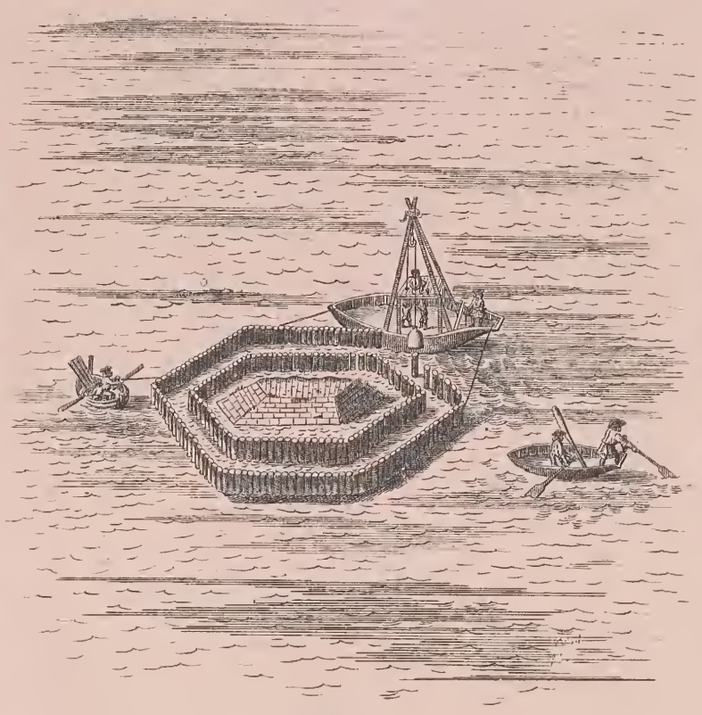
HYDRAULIC ENGINEERING.

631 Patents Granted by the United States.

Seckett & Wilhelms Litho Co New York



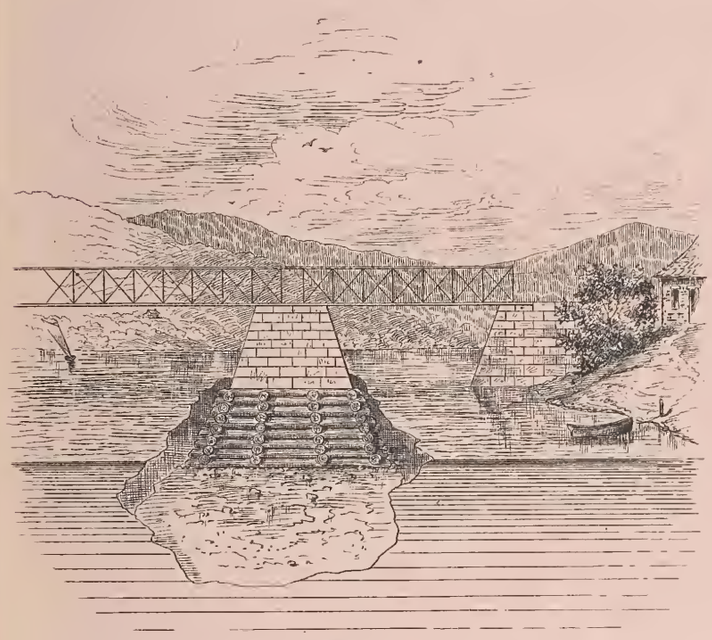
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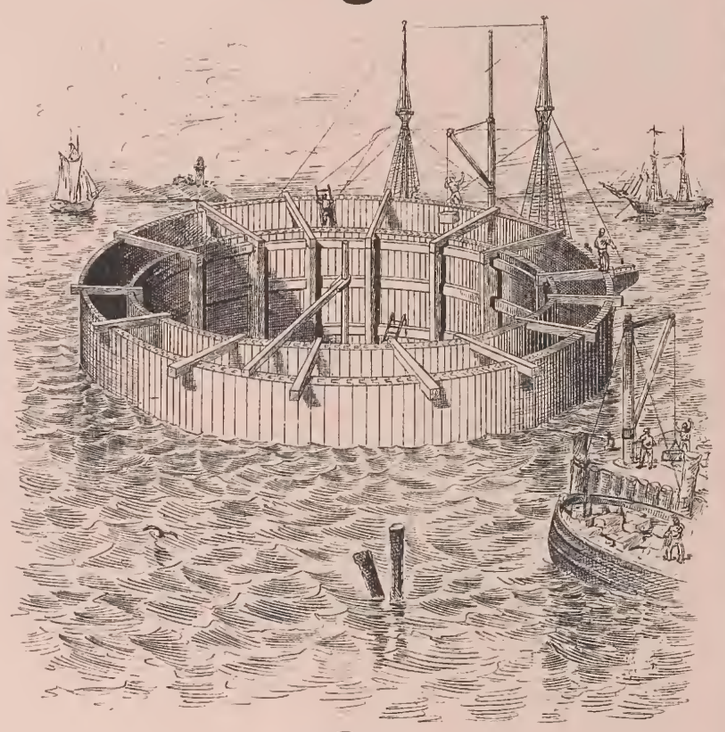
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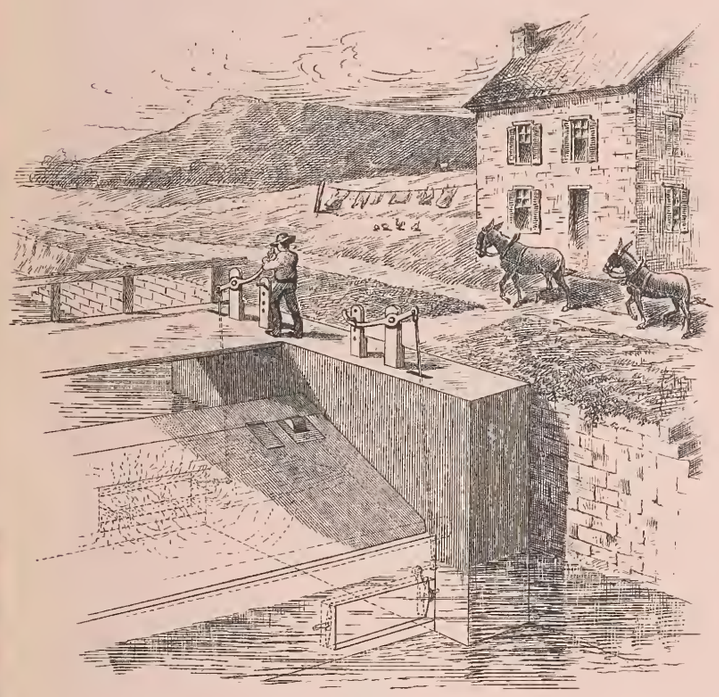
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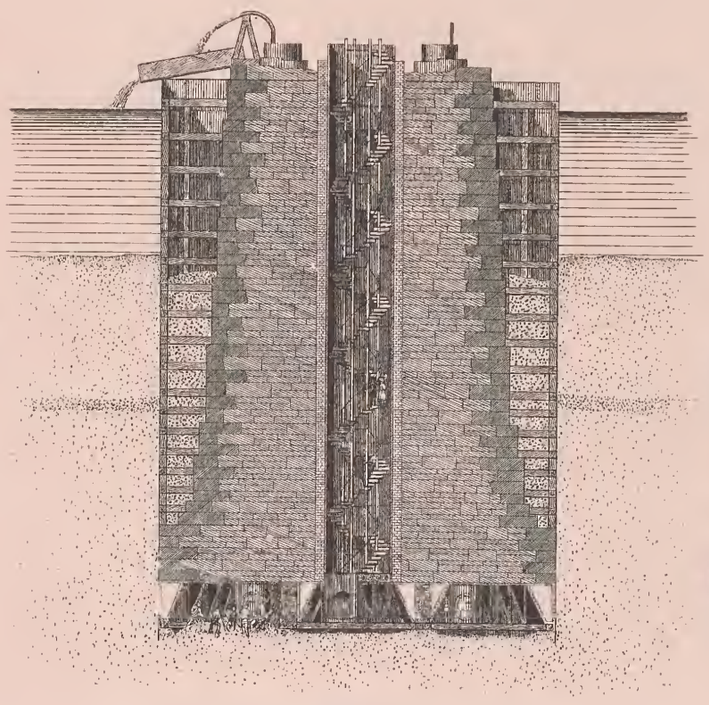
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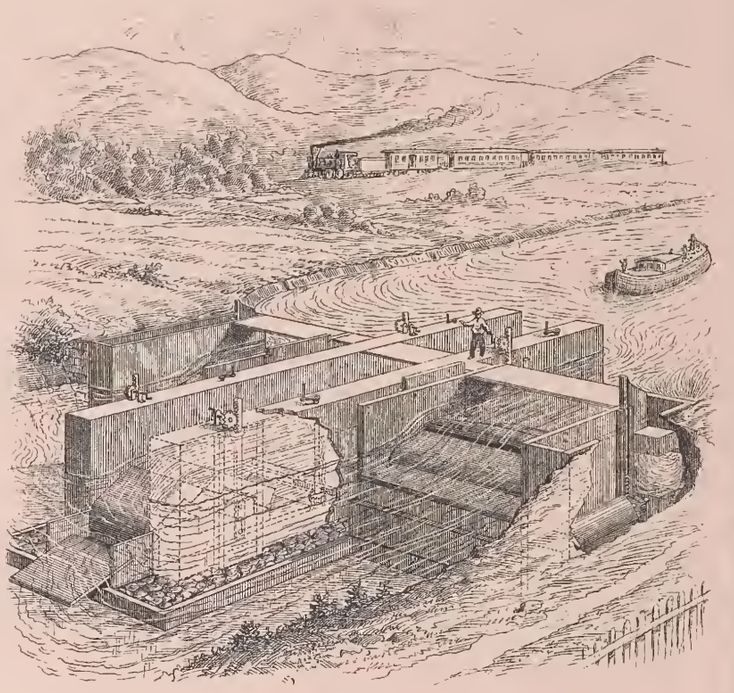
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SUBTERRANEAN AND SUB-MARINE CONSTRUCTIONS.

SUBTERRANEAN AND SUB-MARINE CONSTRUCTIONS.

No. 1. Primitive Tunneling—A. D. 1621.
2 " Coffer Dam—A. D. 1720.
3. " Dam.
4. " Bridge Pier.
5. U. S. Patent, Tunnel—A. D. 1820.
6. " " Coffer Dam—A. D. 1833.
7. " " Bear Trap Dam—A. D. 1849.
8. " " Bridge Caisson—A. D. 1872.
9. " " Bear Trap Dam—A. D. 1880.

Herodotus mentions a tunnel in the Island of Samos cut through a mountain 900 feet high; its length was 4,375 feet, and its cross section 8 feet high by 8 feet wide.

When Cæsar arrived at Alexandria he found the city almost hollow underneath, from the numerous aqueducts.

The Adalbert, a lead-silver mine in Austria, is probably the deepest mine in the world, the perpendicular shaft being 3,280 feet deep.

The next deepest on the continent of Europe is the Viviers coal mine, in Belgium, 2,847 feet deep. This mine penetrated to a depth of 3,586 feet, but, no coal being found, the shaft below the 2,847 feet level has been abandoned.

In England the Dunkirk colliery, Lancashire, has been opened to a depth of 2,824 feet, and the Rockbridge colliery, in the same locality, to a depth of 2,458 feet. These are the deepest mines in Great Britain.

A great engineering enterprise is in progress in Baltimore, Md. A tunnel six and four-fifths miles long is being built underground, over four-fifths of the distance through hard gneiss and granite. When completed it will be the longest tunnel in this country.

The fact that the water supply tunnel lies near enough to the surface to allow of numerous shafts greatly facilitates its construction.

The tunnel is a circle 12 feet in diameter, and extends from the Gunpowder river, about eight miles from the city.

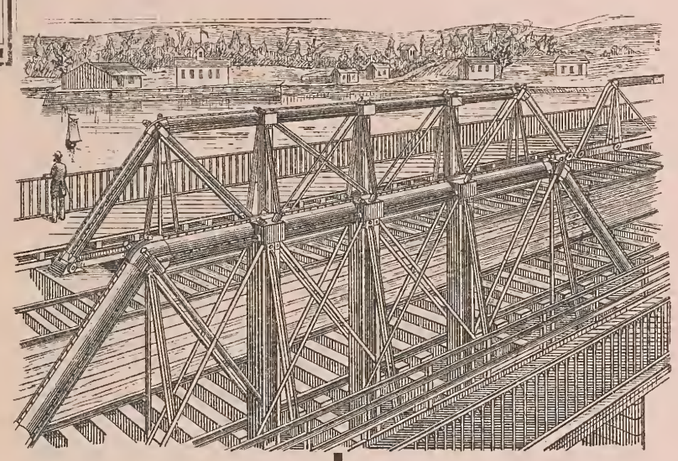
The Croton aqueduct, 42 miles long, supplying the City of New York with water, is the finest of our age.

Among the most celebrated tunnels are the Mt. Cenis, Switzerland, 8 miles long; St. Gothard, 9½ miles long; Hoosac, U. S., 25,000 feet long; Sutro, 3$\frac{24}{100}$ miles long.

SUBTERRANEAN AND SUB-MARINE CONSTRUCTIONS.

427 Patents Granted by the United States.

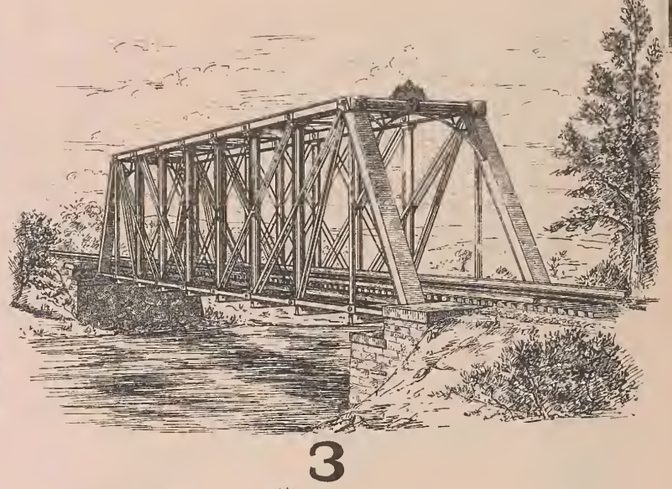
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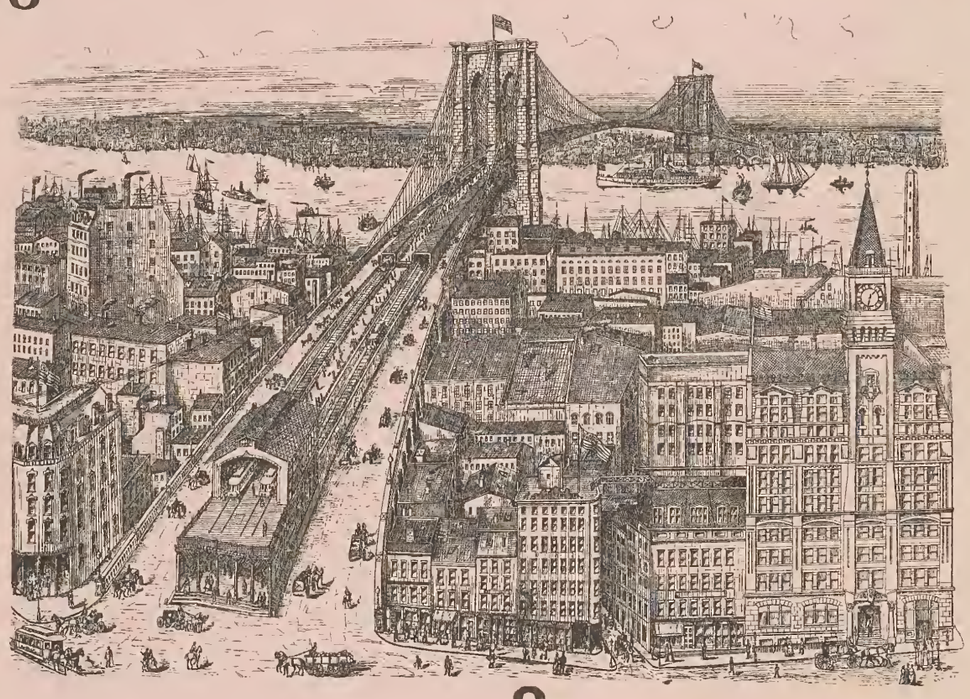
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IRON TRUSS BRIDGES.

IRON TRUSS BRIDGES.

No. 1. U. S. Patent, Iron Column—A. D. 1862
2. " " Arch Beam—A. D. 1873.
3. " " Box Beam—A. D. 1873.
4. " " Center Pivot Swing—A. D. 1882.
5. Pittsburgh Suspension.
6. Niagara Cantilever.
7. St. Louis Iron.
8. East River Suspension.

The first iron bridge built in England was an arch of cast iron sections, erected in 1799, over the Severn river.

Iron suspension bridges are of modern date. The first was constructed in England, in 1819, across the river Tweed.

The bridge over the Menai Strait was built in 1819-'25. Its span is 580 feet.

The Wheeling bridge, United States, was built in 1848. One of the finest structures in the United States is the Niagara railway bridge over the Niagara river. It was completed in 1855, and its span is 821 feet.

Of wrought iron bridges the Britannia and Conway tubular, are widely celebrated. The Victoria railway bridge over the St. Lawrence, at Montreal, is constructed after the plan of the Britannia, and is over two miles long.

Ten truss bridges cross the Mississippi river, above St. Louis, United States. Seven of them have spans as long as the celebrated Tay bridge, of Scotland. Those at Winona, LaCrosse, Dubuque, Keokuk and Hannibal have spans of 240 feet; that at Rock Island 250 feet.

Across the Ohio river, at Steubenville, there is a truss bridge with a span of 320, and one at Parkersburg of 350 feet. The Cincinnati bridge has a span of 515 feet, the longest truss yet built. The proposed bridge over the Hudson, at Poughkeepsie, N. Y., is to have five spans of 500 feet each, with piers 135 feet above high water.

There is a truss bridge over the Vistula, in Europe, with twelve spans of 300 feet each. The truss bridge at Lessart, in France, has a span of 314 feet, and was pushed across from one abutment to the other after being put together. The Kuhlenburg bridge, of Holland, was the monarch truss before the construction of the Cincinnati bridge, and has a span of 492 feet.

Cast iron bridges are of recent origin. A remarkable one is that constructed for the purpose of carrying the Washington Acqueduct over Rock Creek, between the cities of Georgetown and Washington, D. C. The peculiarity is that its arches are constructed of cast iron pipes, which carry the roadway and water supply at the same time. Its span is 200 feet.

The greatest bridge now in existence is the suspension bridge over the East river, New York, connecting the cities of New York and Brooklyn. It is 3,475 feet in length.

The bridge in course of erection for the Baltimore and Ohio Railroad, over the Susquehanna river, at Port Deposit, Md., when completed will be the largest railroad bridge in the world. It will be 6,830 feet long.

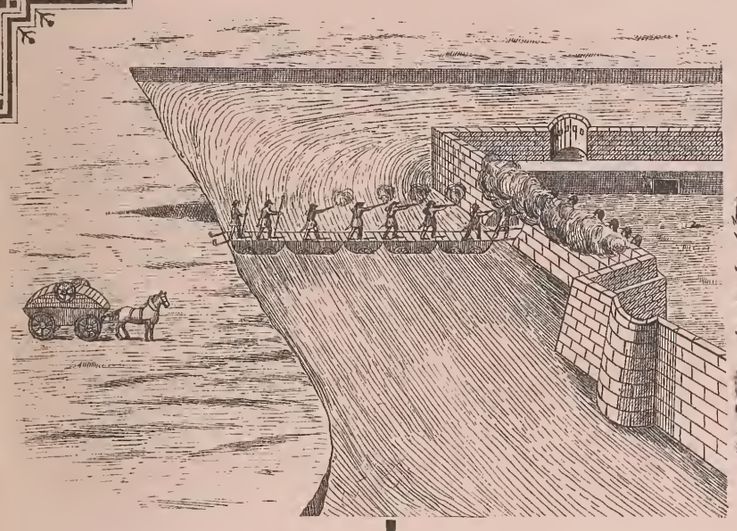
IRON TRUSS BRIDGES.

75 Manufactories in the United States.

	1860	1880
Capital Invested,	$61,500.00	$4,058,649.00
Value of Productions,	192,500.00	8,978,122.00
Wages Paid,	51,720.00	1,882,179.00
Hands Employed,	96	4,293

706 Patents Granted by the United States.

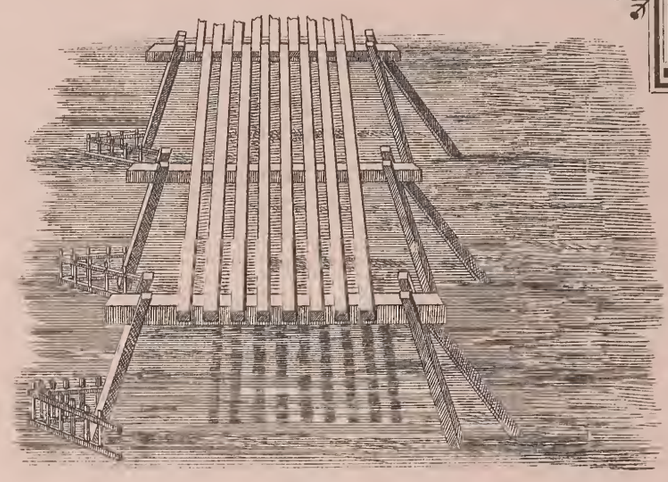
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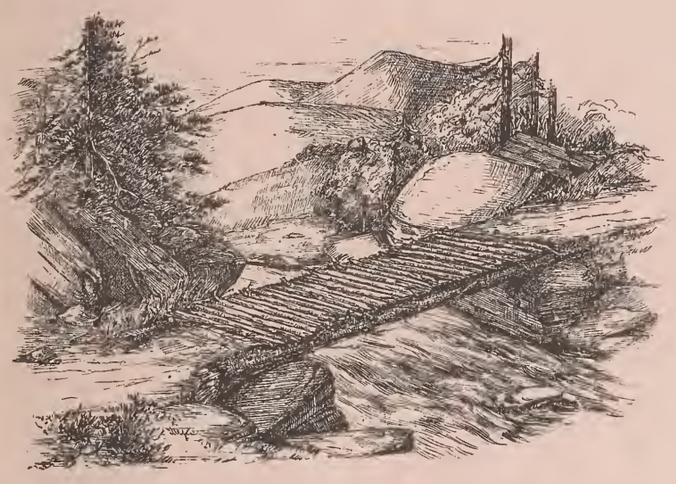
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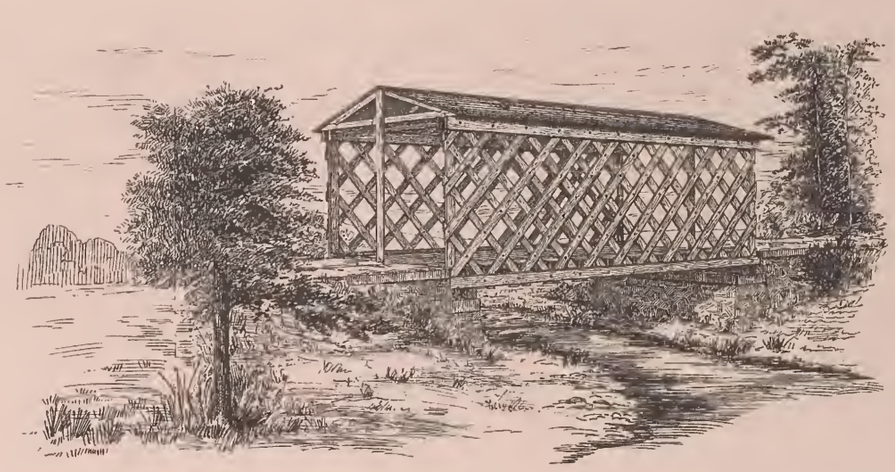
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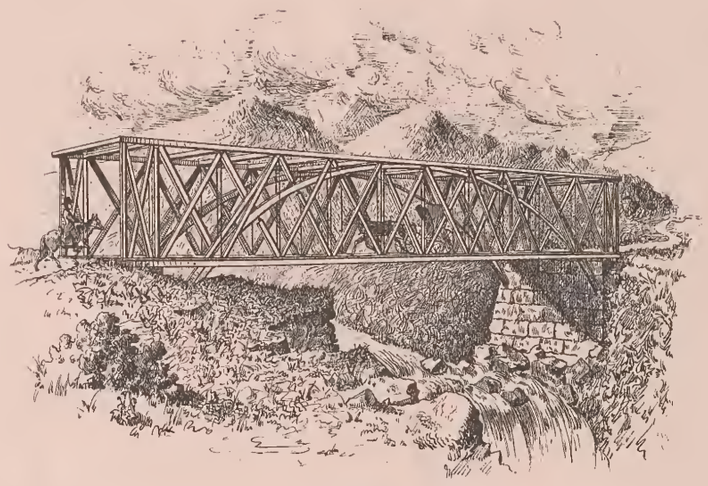
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10

TIMBER AND STONE BRIDGES.

TIMBER AND STONE BRIDGES.

No. 1. Ancient Pontoon.
2. Peruvian Rope.
3. Cæsar's Timber.
4. Primitive Log.
5. " Stone.
6. English Winch Bridge.
7. U. S. Patent, Timber—A. D. 1817.
8. " " Lattice—A. D. 1820.
9. " " Timber Truss—A. D. 1840.
10. " " " Arch Brace Truss—A. D. 1846.

The ancient bridge across the Euphrates, at Babylon, consisted of wooden spans, supported by stone piers. Cæsar's bridge over the Rhine was of wood, built upon piles, and was erected 55 B. C.

The bridge of Trajan, across the Danube, had twenty-two wooden arches and twenty-three piers.

Wooden bridges of the middle ages were generally supported upon piers composed of one or more rows of piles. The celebrated wooden bridge over the Rhine, erected in 1757, had a span of three hundred and sixty-four feet.

The widest span ever formed of timber was over the Limmat, in Switzerland, and was built about the eighteenth century. The span of its wooden arch was three hundred and ninety feet, with a rise of forty-three feet.

The lattice bridge has generally, in practice, been combined with the arch when great strength and rigidity are required.

The widest single span wooden bridge built in the United States is over the Schuylkill, at Philadelphia, Pa. The span is three hundred and forty feet. Bridge building was one of the arts brought to perfection during the civil war in the United States. The Rappahannock river bridge, Va., during the war was rebuilt in nineteen working hours; it was six hundred and twenty-five feet long, and thirty-five feet high. The Potomac Creek bridge, four hundred and fourteen feet long, eighty-two feet high, was rebuilt in forty working hours. That between Tunnel Hill and Resaca, twenty-five miles of permanent way and two hundred and thirty feet of bridges, was constructed in seven days.

Stone bridges originated among the Romans, who were the first to employ the arch on an extended scale; one with six arches, which was commenced by Augustus, and finished by Tiberius, still exists at Rimini. The first stone bridge was built in England, in 1118.

The old London bridge was built in 1176, burned in 1212, and restored in 1300. The new bridge was opened in 1831; the original piles of the old bridge, which were of elm wood, were found to be but partially decayed.

Later, the plan of sinking caissons to form pier foundations was introduced; the coffer dam succeeded these, to be itself succeeded by the pneumatic caisson. In the construction of stone bridges, when the pneumatic caisson is used, the river bed is excavated until firm bottom is reached; the abutments and piers of masonry are built up to the springing points of the arches, which are then turned up on the wooden centerings which serve as a former for the arch, and support for its weight, until the keystone course is laid.

The arch of the Washington Aqueduct, over Cabin John Creek, Md., has two hundred and twenty feet span, is four hundred and fifty feet long, and twenty feet, four inches wide. The elevation of the roadway above the bed of the stream is one hundred feet, and is the largest span of a stone bridge in the world.

The next largest is the Chester, over the river Dee, at Chester, England, the span being two hundred feet.

Most of the three hundred and thirty-nine bridges in Venice are of stone.

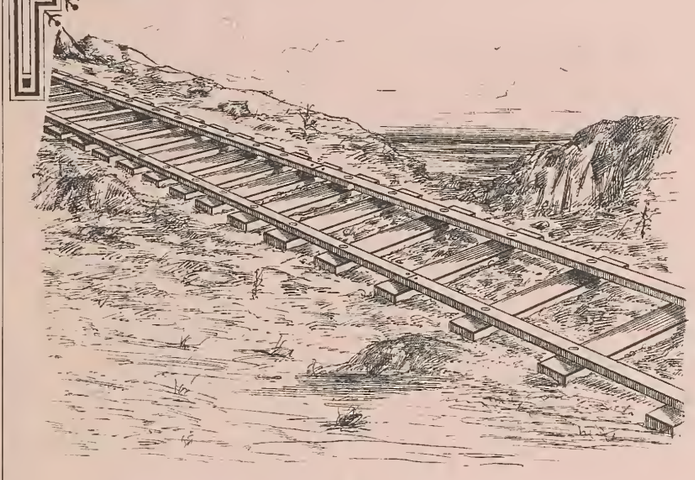
TIMBER AND STONE BRIDGES.

75 Manufactories in the United States.

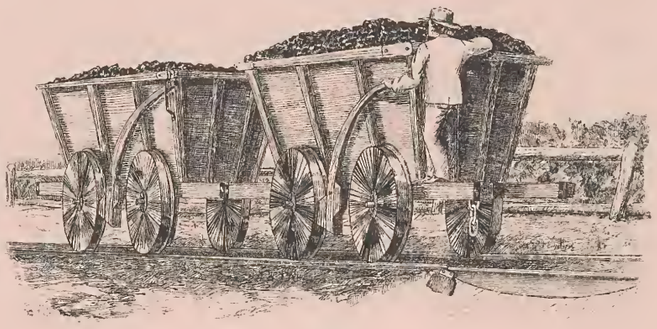
	1860	1880
Capital Invested,	$61,500.00	$4,058,649.00
Value of Productions,	192,500.00	8,978,122.00
Wages Paid,	51,720.00	1,882,179.00
Hands Employed,	96	4,293

706 Patents Granted by the United States.

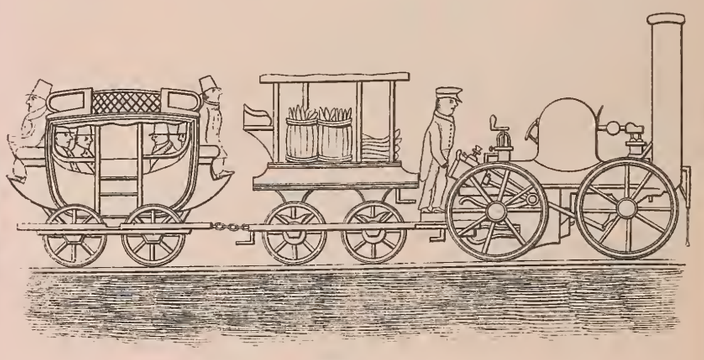
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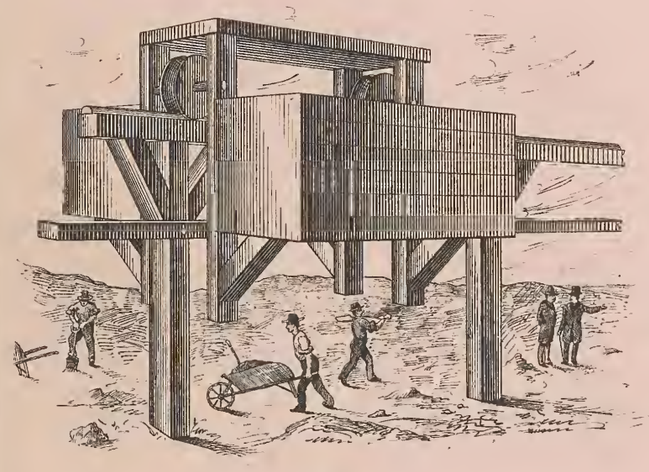
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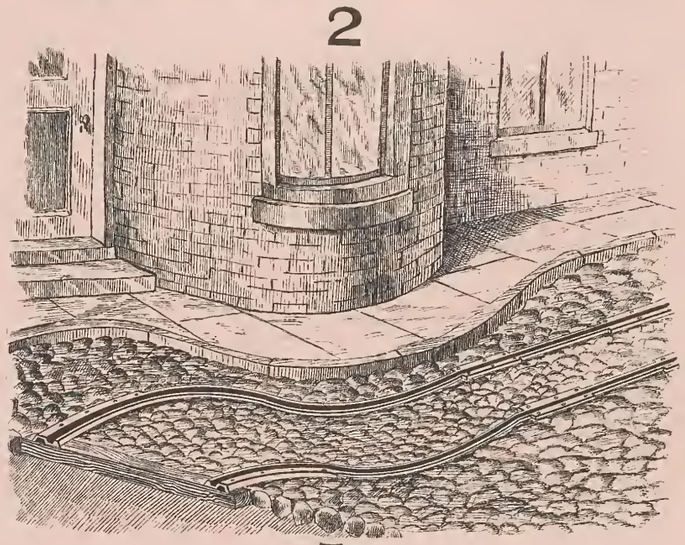
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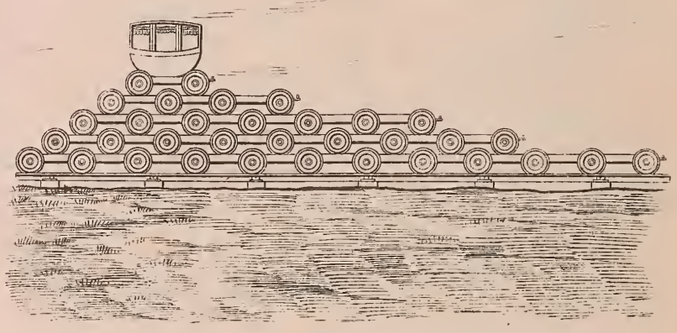
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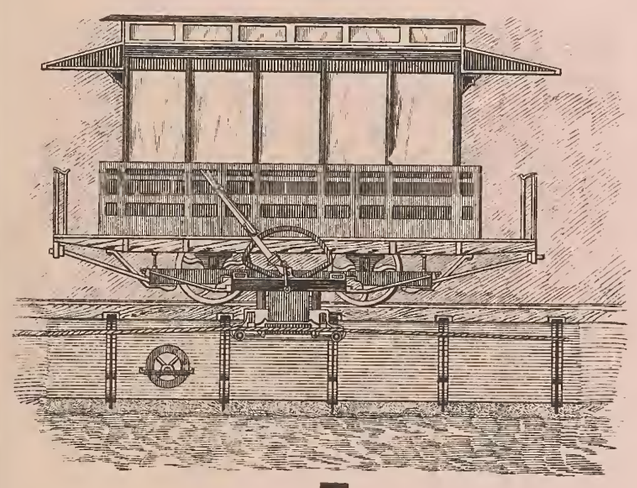
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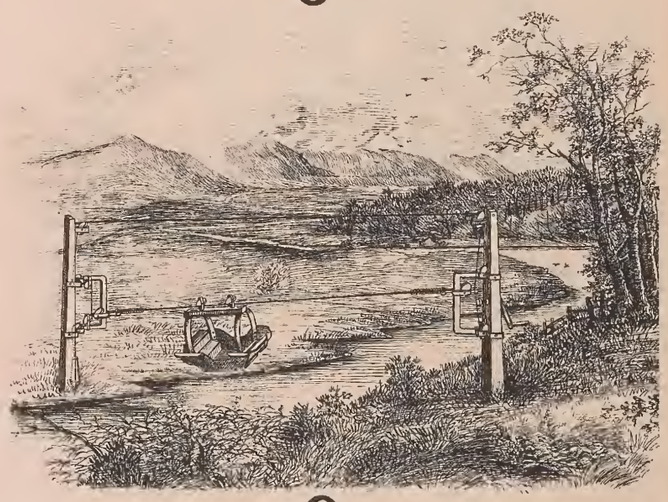
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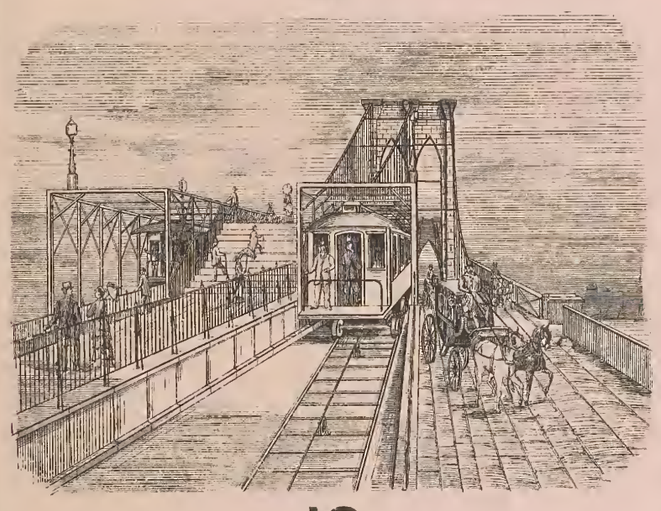
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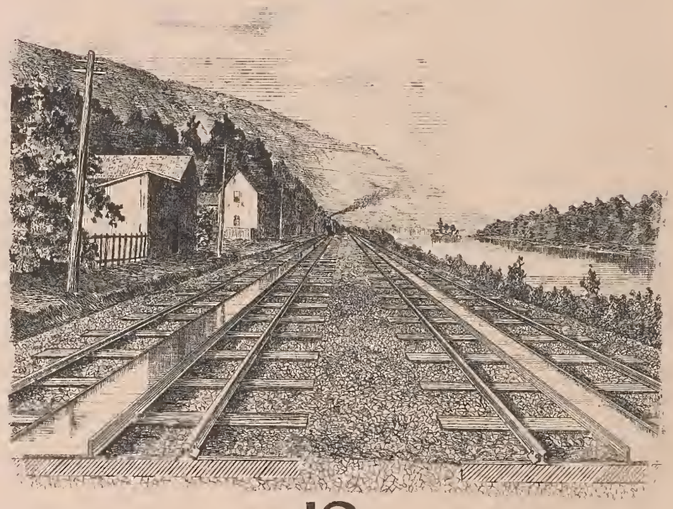
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12

RAILWAY SYSTEMS.

RAILWAY SYSTEMS.

1. Primitive English Railway—A. D. 1676.
2. " Coal Wagon Road—A. D. 1790.
3. First Train from Albany to Schenectady, N. Y.—A. D. 1831.
4. U. S. Patent, Saddle Bag Railway—A. D. 1825.
5. " " Street Railway—A. D. 1831.
6. " " High Speed System—A. D. 1838.
7. " " Underground Cable System—A. D. 1876.
8. " " Elevated Railway—A. D. 1880.
9. " " Inclined Wire and Suspended Car—A. D. 1882.
10. " " Bridge Traction System—A. D. 1884.
11. " " Pneumatic Despatch System—A. D. 1884.
12. " " Standard Railway Track—A. D. 1884.

The first legislative act of England authorizing a public railroad was granted by Parliament in 1801, to the Surrey Iron Tram Road, nine miles long, on which horse power was used.

The first public road on which steam was applied was the Stockton and Darlington, twenty-five miles long, opened September 26, 1825.

In 1826 a railroad was constructed in the United States from the quarries at Quincy, Mass., to tide water, a distance of three miles.

The Baltimore and Ohio laid the first stone for their road on July 4, 1828.

One of the most wonderful feats of railroad engineering is the road from Lima to Callao, in Peru. It runs through a section of country abounding in rich silver mines. It was conceived and built by an American (Meiggs), to the crest of the Andes Mountains.

The railway mileage of the United States and Canada is about 120,000 miles.

The distances traversed by some of the principal roads are as follows:

	Miles.
Missouri Pacific,	6,045
Chicago, Milwaukee and St. Paul,	5,804
Chicago and Northwestern,	5,645
Pennsylvania,	4,807
Union Pacific,	4,748
Central Pacific,	4,194
Wabash, St. Louis and Pacific,	3,507
Vanderbilt roads,	3,066
Grand Trunk,	2,950
Atchison, Topeka and Santa Fé,	2,799
Southern Pacific,	2,789
Baltimore and Ohio,	2,737
Northern Pacific,	2,548
Louisville and Nashville,	2,366

The United States was the first country to introduce Street Railways for Passenger Cars, and the first street railway was established in 1850.

There are in the United States and Canada 415 street railways, employing 100,000 horses and 8,500 men.

Rope railways are used on inclined planes in mining districts. They have recently come into use on street railways, the cars being drawn by wire ropes wound around drums rotated by stationary engines.

Among the latest inventions is the store service or warehouse railway.

The American Code of Railway Signals adopted and universally understood are: one whistle of locomotive means "down brakes;" two whistles, "off brakes;" three whistles, "back up;" continued whistles, "danger;" a continued succession of short whistles is the "cattle alarm." The conductor's signal, given by a sweeping motion of the hand on a level with the eyes, means "go ahead;" a downward motion of the hand, "stop;" a beckoning motion, "back." A lantern raised and lowered vertically, "start;" swung at right angles or across the track, "stop;" swung in a circle, "back." A red flag waved on the track, "danger;" hoisted at a station, "stop;" stuck up on the roadside, "danger on the track ahead;" carried unfurled on an engine, "another engine is on its way."

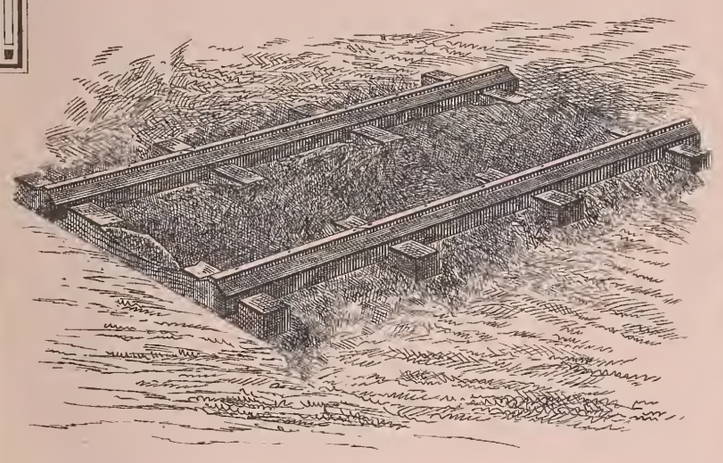
RAILWAY SYSTEMS.

1,017 Railroad Companies in the United States.

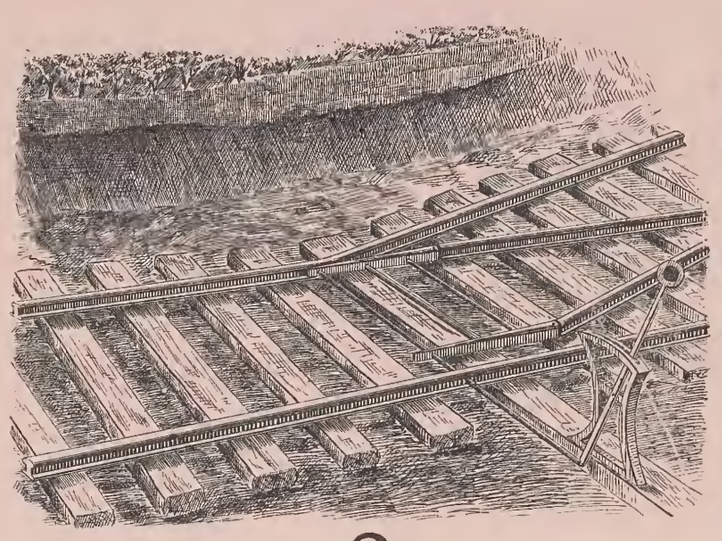
	1880
Miles of Road Operated,	87,781
Capital Invested,	$5,182,445,807.00
Wages Paid,	195,350,013.00
Hands Employed,	418,957

3,740 Patents Granted by the United States.

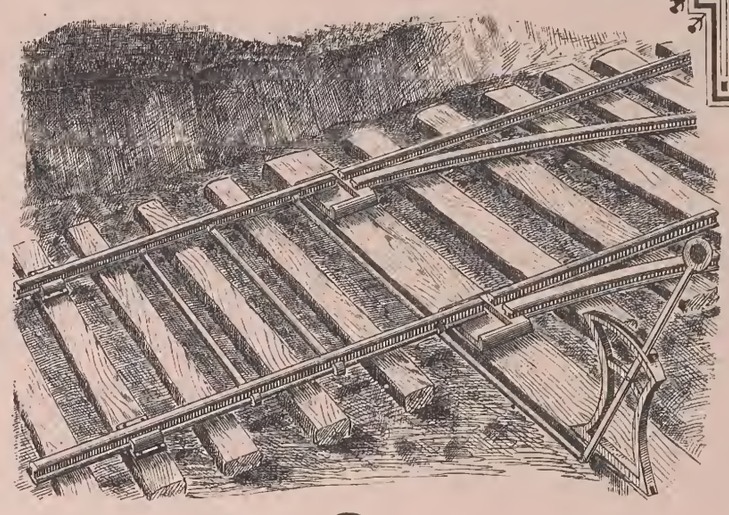
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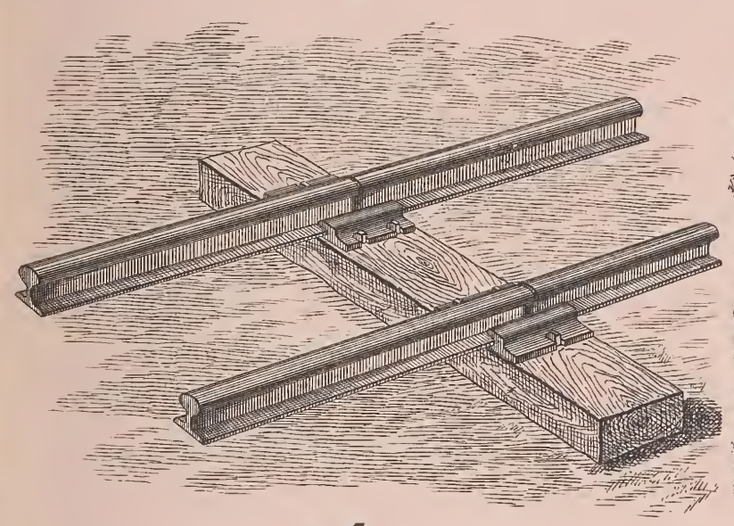
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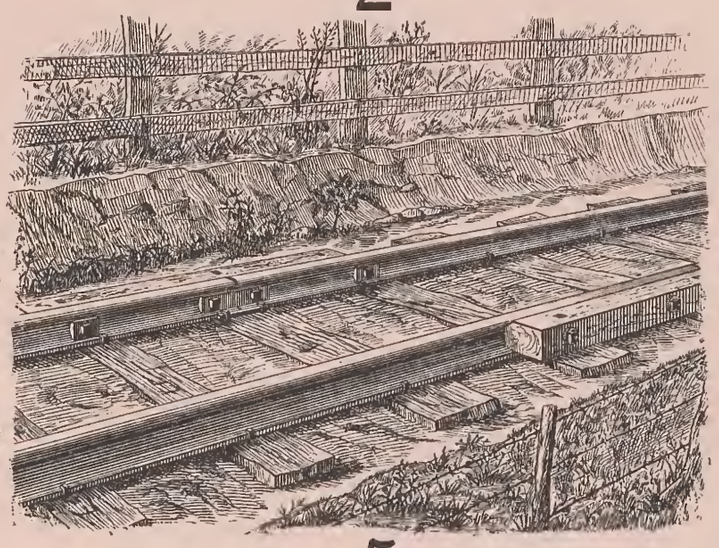
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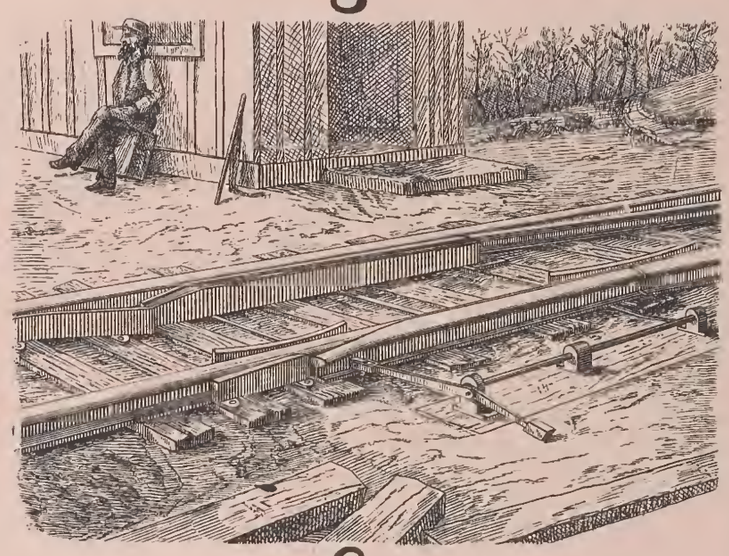
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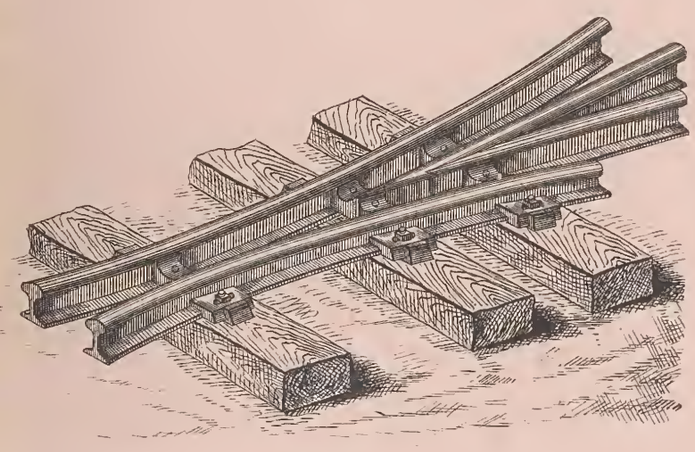
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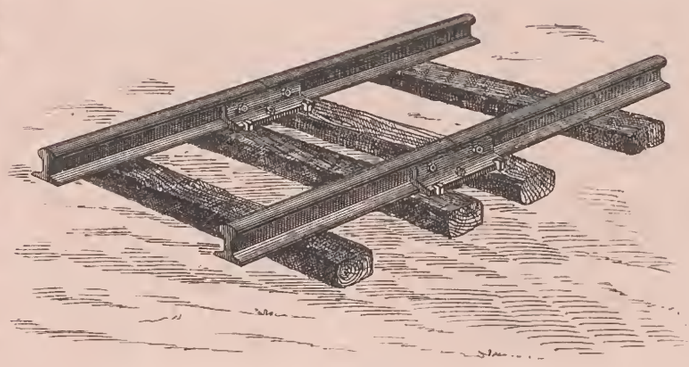
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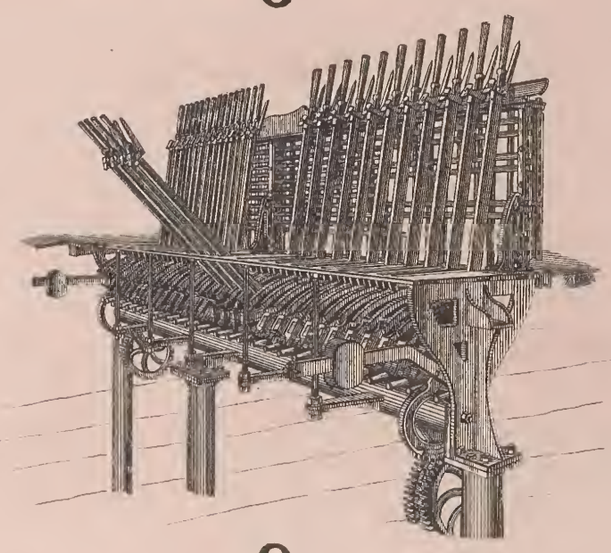
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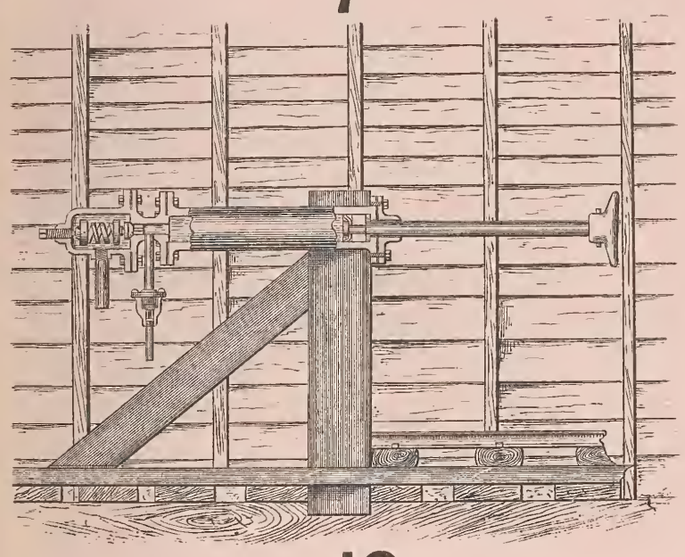
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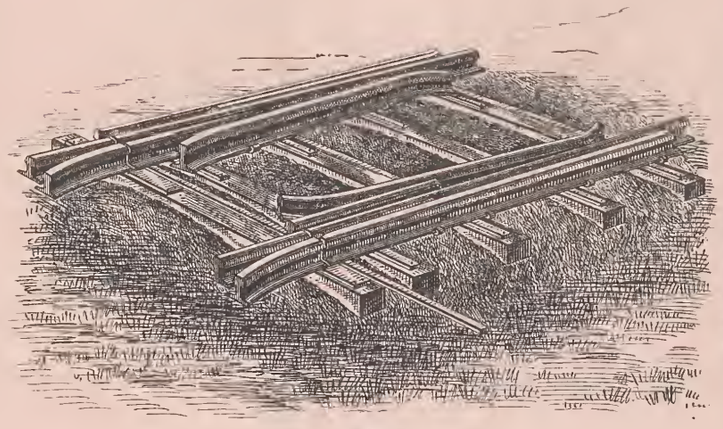
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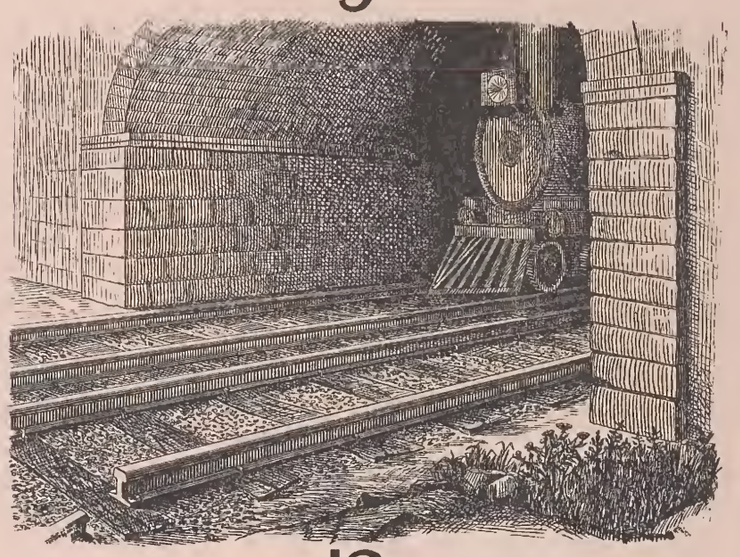
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RAILWAY TRACK APPLIANCES.

RAILWAY TRACK APPLIANCES.

1. Primitive Snake Head Rail.
2. " Point Switch.
3. " Stub Switch.
4. " Chair Joints.
5. U. S. Patent, Fish Joint—A. D. 1854.
6. " " Uncut Main Rail Switch—A. D. 1871.
7. " " Frog—A. D. 1874.
8. " " Fish Joint—A. D. 1879.
9. " " Switch and Signal Interlocking—A. D. 1880.
10. " " Hydraulic Buffer—A. D. 1881.
11. " " Safety Switch—A. D. 1882.
12. " " Steel Rail—A. D. 1884.

The Egyptians learned, in moving the great stones from the quarries for their pyramids, the advantage of solid trackways; and the remains of such, formed of blocks of stone, are said to have been found on the line of the great roads they constructed for this purpose.

Wooden rails were laid at Newcastle, England, in 1602. "The rollers of the carts were made to fit the rails." They consisted of timber laid exactly straight and parallel.

The Coalbrook-Dale iron works, in 1767, laid down flat cast iron rails.

Cast iron rails on wooden sleepers were used at the Duke of Norfolk's colliery, near Sheffield, England, in 1776.

Edge rails were introduced in 1789.

The fish-bellied rail was introduced in 1805, and the flanged in 1816.

In the construction of the Baltimore and Ohio Railroad, in 1828, longitudinal rails were used, pinned down to wooden cross ties; upon the rails were fastened flat iron bars; this method was generally adopted upon early American roads.

The ends of the rails becoming loose were occasionally caught by the wheels and forced up into the bottom of the cars, and were thus termed snake-head rails.

Grimes' English patent, of 1831, specifies a hollow rail charged with steam from stationary boilers at intervals of two or three miles to keep the rails clear of ice and snow.

The first steel rail was made in 1857. The substitution of steel for iron rails has worked a great change in the condition of ways.

The average life of an iron rail is said to be five years.

The average width of rails is from two and one-fourth to three inches. The usual gauge of rails in England and the United States is four feet eight and one-half inches.

It is estimated that there are 391,000,000 railway ties in use in the U. S., and that there are about 200,000 miles of railway tracks in the world.

Railroad track appliances are classified in the U. S. Patent Office as follows:

Car Replacers.	Track.
Chairs.	Track Fastenings.
Crossings.	Track Portable.
Deadening Noise.	Track Stringers and Ties.
Frogs.	Track Cleaners.
Foot Guards.	Track Cleaners, Centrifugal.
Foot Bridges.	Track Cleaners, Dumping.
Rails.	Track Cleaners, Elevators.
Rail Joints.	Track Cleaners, Melters.
Single Rail.	Track Cleaners, Snow Plows.
Switches.	Track Cleaners, Wheel and Fender.
Automatic Rail.	Track Layers.
Pneumatic Rail.	Track Platforms.
Tramway Rail.	Transfer Tables.
Switch Stands.	Turntables.
Interlocking.	

RAILWAY TRACK APPLIANCES.

1,017 Railroad Companies in the United States.

	1880
Miles of Road Operated,	87,781
Capital Invested,	$5,182,445,807.00
Wages Paid,	195,350,013.00
Hands Employed,	418,957

3,740 Patents Granted by the United States.

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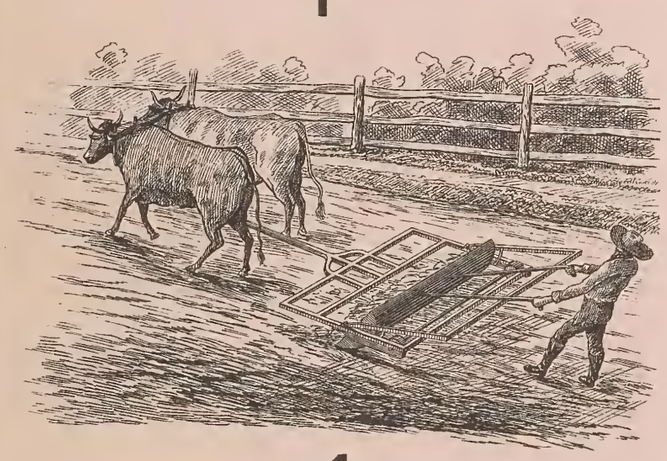
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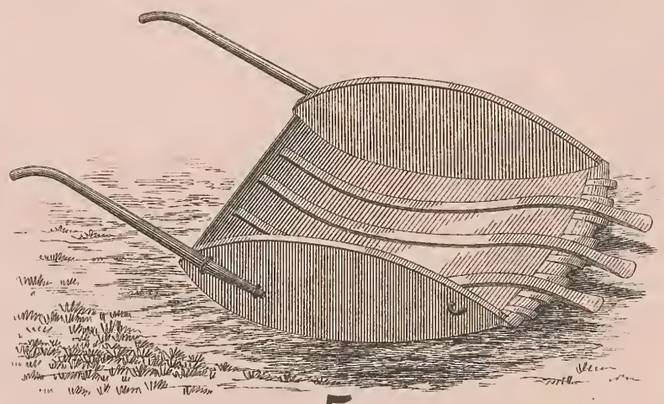
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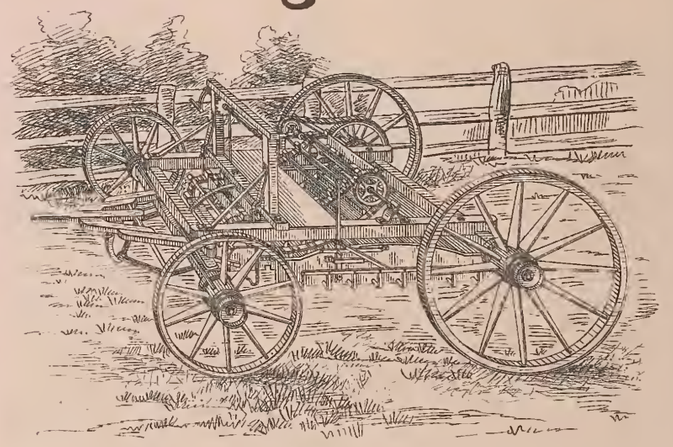
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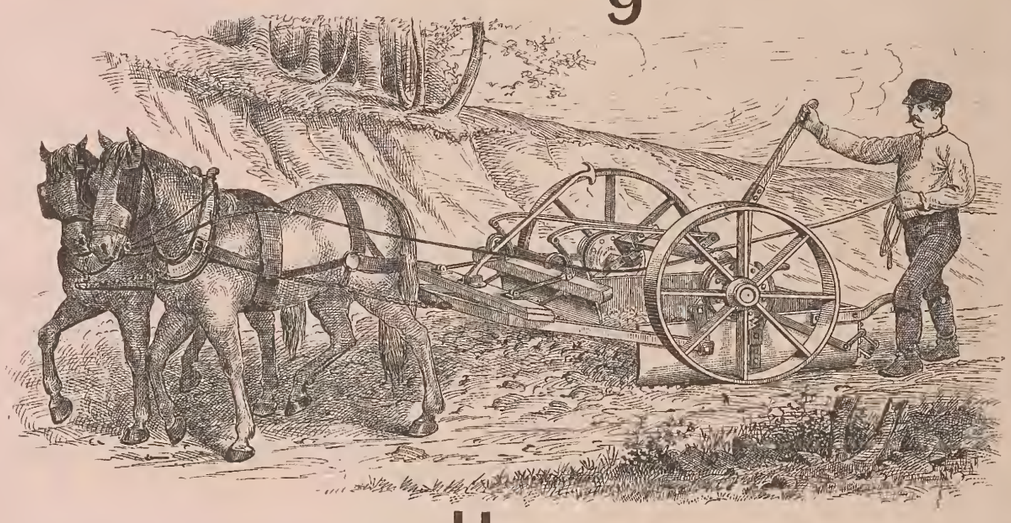
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ROAD MAKING MACHINES.

ROAD MAKING MACHINES.

No. 1. Primitive Leveller.
2. " Carrying Scraper.
3. U. S. Patent, Sulky " —A. D. 1831.
4. " " Wheel " —A. D. 1839.
5. " " Drag " —A. D. 1850.
6. " " Self-Loading Cart—A. D. 1850.
7. " " " " —A. D. 1867.
8. " " Revolving Scraper—A. D. 1879.
9. " " Self-Loading Cart—A. D. 1881.
10. " " Road Builder—A. D. 1883.
11. " " Wheel Scraper—A. D. 1884.

The Carthagenians invented paved roads. The Romans paved their roads on a foundation of rough stones consolidated in a mass of mortar, which became solid, making a smooth and lasting road. These roads were built into the most distant provinces for the purpose of facilitating the march of their soldiery and the transportation of supplies. Isidore, a Greek architect of the sixth century, says "the Romans made roads almost over the known world."

Twenty-nine great military roads centered in Rome, which was divided into eleven regions, one hundred and thirteen provinces, and traversed by three hundred and seventy-two great roads, with a length of fifty-two thousand, nine hundred and sixty-four Roman miles.

The first of the great roads was the Appian Way, which was constructed by Appius Claudius Cæcus, 331 B. C.; the stones were hewn and closely fitted. Although more than twenty centuries have passed since its construction it is still entire in many places.

During the last African war a paved road was constructed through Spain and Gaul to the Alps. These roads connected the Capital with Savoy, Dauphine, Province of Germany and all parts of Spain, Gaul, Constantinople, Hungary, Macedonia and the mouth of the Danube on the other sides of the intervening waters; these roads extended into Sicily, Corsica, Sardinia, England, Asia and Africa. The Roman roads were distinguished by the names Via, Actus, Iter, Semiter, Trames, Callais, etc.

The Via was eight feet wide, and was considered the best.

The Via Militore, near Rome, was double width, or sixteen Roman feet; the middle was paved and divided from the sidewalk by a curb two feet wide and eighteen inches high. The middle was for the infantry and the margin for carriages and equestrians.

The Actus was four feet wide, and was used for single carriages.

The Iter was for horsemen, pack animals and pedestrians, and was three feet wide. The Semiter was eighteen inches wide.

The Callais was a mountain path.

Roman military roads were made with four strata with composite thickness of about three feet. The stratumen consisted of two courses of flat stones laid in mortar; the sudus was a rubble of broken stone, mixed with one-third the quantity of quicklime well rammed. The nucleus was a mixture of brick, broken tiles and one-third the quantity of lime or gravel, and the stated proportion of lime laid on while hot from slacking.

In Persia the royal roads ran beside the common roads, and were used only by the King; they were kept in much better order than other roads, and were called "the King's highway."

The Moguls constructed roads in India with "distance stones" at the end of every Koss.

The Grand Trunk road connecting Calcutta with Peshawur on the borders of Afghanistan was built by the British.

The Roman roads of England were built in the second, third and fourth centuries, criminals and Roman soldiery being employed thereon. The four principal were from Kent, via London, to Cardigan Bay in Wales; from St. Davids, Wales, via Birmingham, Derby and York, to Tynemouth; from Cornwall to Lincoln, and from St. Davids to Southampton. The Britons neglected the roads built by the Romans. The English government made little attempt to improve the roads till the reign of Charles II.

Highways were first made public in England by the Romans. Edward I ordered the roads widened and cleared of trees within two hundred feet of the road to prevent robberies.

The road built by Napoleon, from Geneva to Milan, cost the French Government three million, two hundred and fifty thousand dollars.

"Macadamized roads," are named from the inventor, MacAdam, who used small, angular broken stone of a hard variety. He was made Surveyor General of the roads of Bristol.

The National road of the United States, from Baltimore across the Alleghanies, extends six hundred and fifty and five-eighths miles, and is macadamized for thirty feet of its width.

ROAD MAKING MACHINES.

466 Patents Granted by the United States.

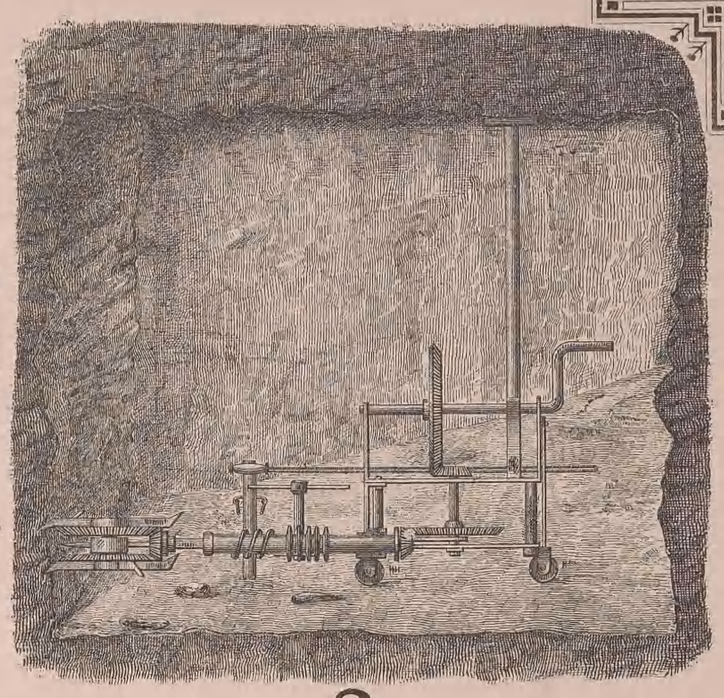
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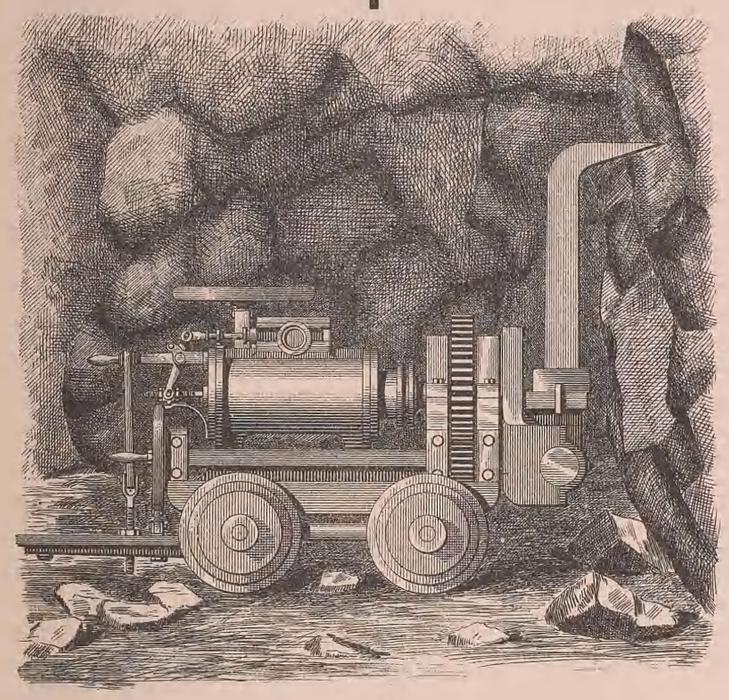
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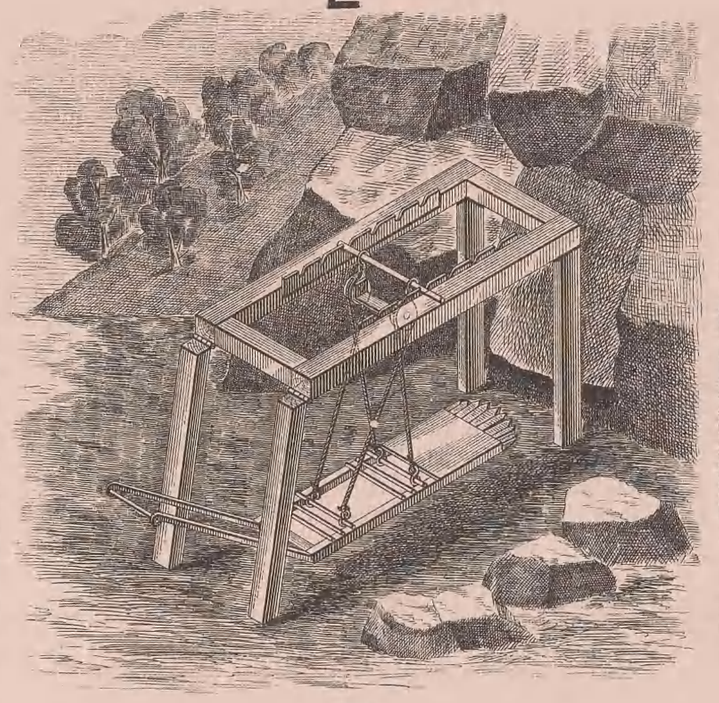
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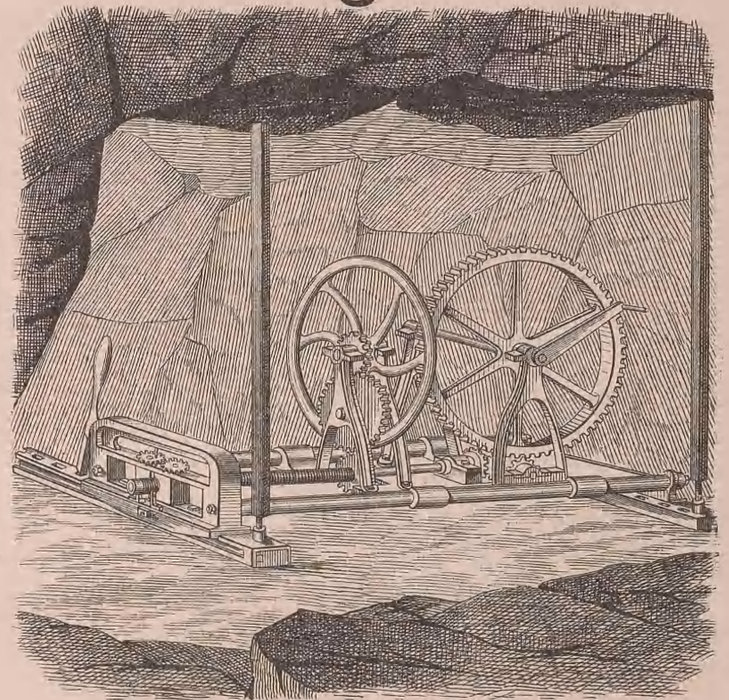
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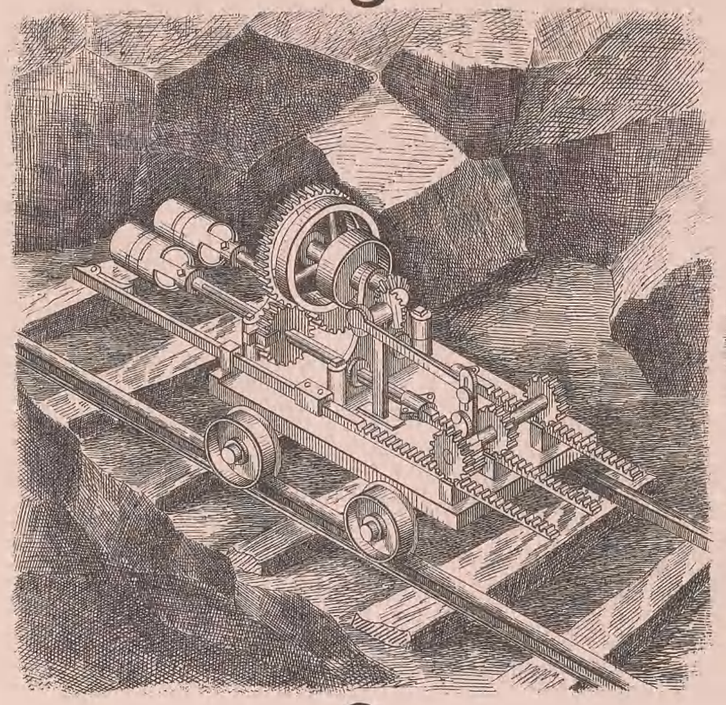
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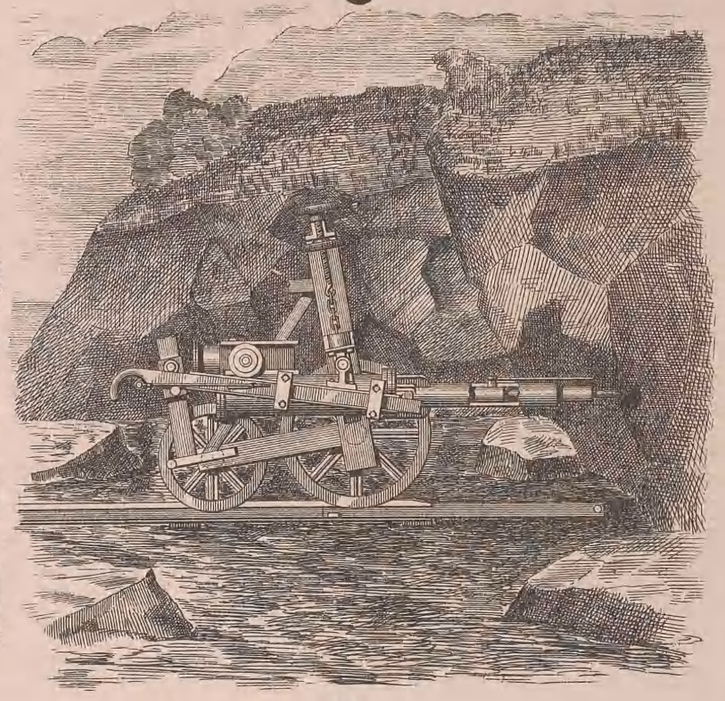
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9

MINING STONE AND COAL.

MINING STONE AND COAL.

No. 1. Primitive Mining.
2. " French Mining.
3. U. S. Patent, Mining Machine—A. D. 1865.
4. " " Coal Mining Machine—A. D. 1865.
5. " " " Digging " —A. D. 1870.
6. " " " Boring " —A. D. 1873.
7. " " " Cutting " —A. D. 1877.
8. " " " Mining " —A. D. 1883.
9. " " " " " —A. D. 1884.

The stones for building the Obelisk and Colossi of Egypt were taken from the limestone hills which border and inclose the valley of the Nile. The largest stones in any known building are those of the temple platform at Baalbek. The Egyptian mode of quarrying was by uncovering the stratum of the stone, leveling the surface, and working out an area sufficient to yield the amount of stone squares. Around this was cut a deep trench, and cross trenches at right angles divided the whole area into squares of such a size as was required. Layer after layer was then removed. The masses of granite may have been detached from their beds in the same manner as is now practiced in the East. After the stone is surrounded by a trench it is heated by fire built upon it; the ashes being swept off, water is poured into the groove by a large number of men simultaneously, when the fracture takes place through the whole line. Wooden pins inserted into a row of holes and swelled by water was another method.

Newcastle coal was known and used as fuel more than 800 years ago. Anthracite was first made known to the white settlers of Pennsylvania in 1768.

In 1784 coal mining began in the vicinity of Pittsburgh. In 1791 the Mauch Chunk coal discoveries were made, and soon afterwards the Lehigh Coal Mining Co. was organized.

There seems to have been for a long time a prejudice against anthracite, but the war of 1812, which raised the price of bituminous coal, called renewed attention to the Pennsylvania coal and to means of mining and transporting it.

In 1820 the anthracite coal busines may be said to have really begun, by the shipment of 325 tons by the Lehigh Coal and Navigation Co. to Philadelphia.

Coal, according to its location, and the lay or dip of the strata, is often worked by quarrying into the side of a hill or mountain, or, when the beds are deep, shafts are sunk, galleries are formed by taking out the coal, and tracks laid down for the transportation of the coal from the different parts of the mine to the shafts, where it is hoisted.

The miners use picks, and huge masses of coal are thrown down by wedges driven into long grooves made into the vein, and sometimes by light charges of powder. Columns of coal are left and timbers set up to support the roof. Steam power does the hoisting and lowering and runs the breakers which break the coal brought up from the mines. The coal is separated by screens into lump, egg, broken stone, and pea sizes.

In the granite quarries, near Seringapatam, the most enormous blocks are separated from the solid rock by the following simple process: The workman, having found a portion of the rock sufficiently extensive, and situated near the edge of the part already quarried, lays bare the upper surface and marks a line on it in the direction of the intended separation, along which a groove is cut, with a chisel, about two inches in depth. A narrow line of fire is then kindled above this groove and maintained till the rock below is thoroughly heated, when a line of men and women, each provided with a pot full of cold water, suddenly sweep off the ashes and pour the water into the heated groove, when the rock at once splits, with a clean fracture. Square blocks, of six feet in the side and upwards of eighty feet in length, are sometimes detached by this method, or by another equally simple and efficacious, but not easily explained without entering into particulars of mineralogical detail.

The compendium of the tenth census contains some figures which will serve to give an idea of the magnitude of the quarrying interests of the country, which in 1880 gave employment to 39,723 men, 8,059 horses and 851 mules; had 339 machines for quarrying, 2,290 machines for hoisting, 1,308 machines for dressing, and used $192,175 worth of explosives. The capital invested is given at $25,414,497, and the value of the product in the census year at $18,356,055, there being 1,525 quarries in all. Marble and limestone lead the list with 65,523,965 cubic feet, followed by the sandstone quarries with 24,776,930 cubic feet; crystalline silicious rocks with 5,188,998 cubic feet; and slate with 457,267 squares, or 4,572,670 cubic feet. Probably the most extensive quarries of red, free or brown stone in the world are on the Connecticut river at Middletown. These quarries have been worked since 1645.

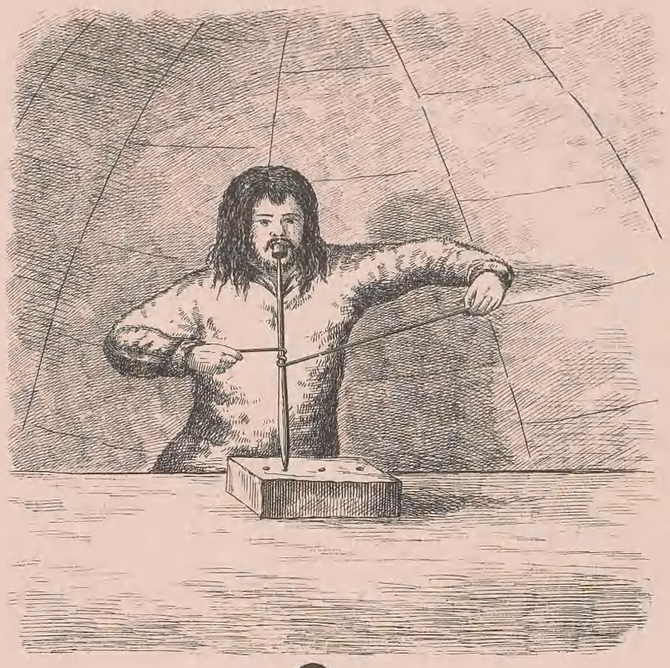
MINING STONE AND COAL.

178 Patents Granted by the United States.

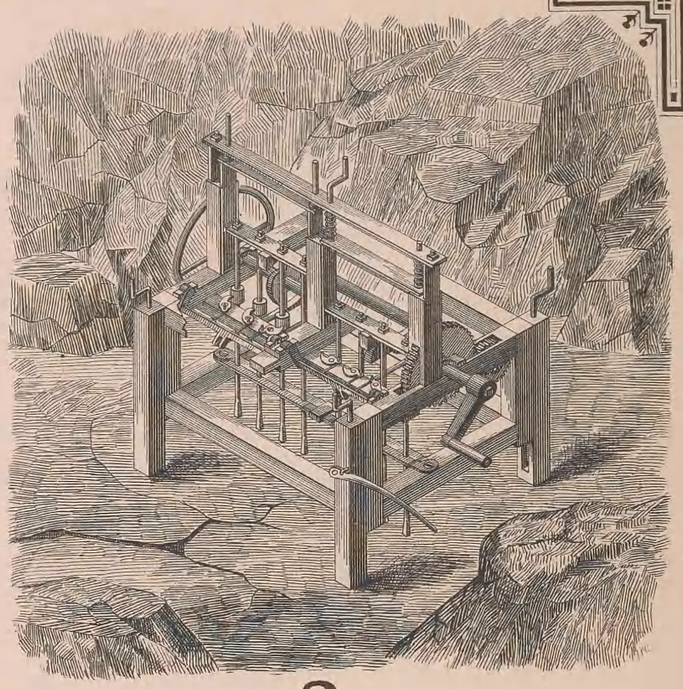
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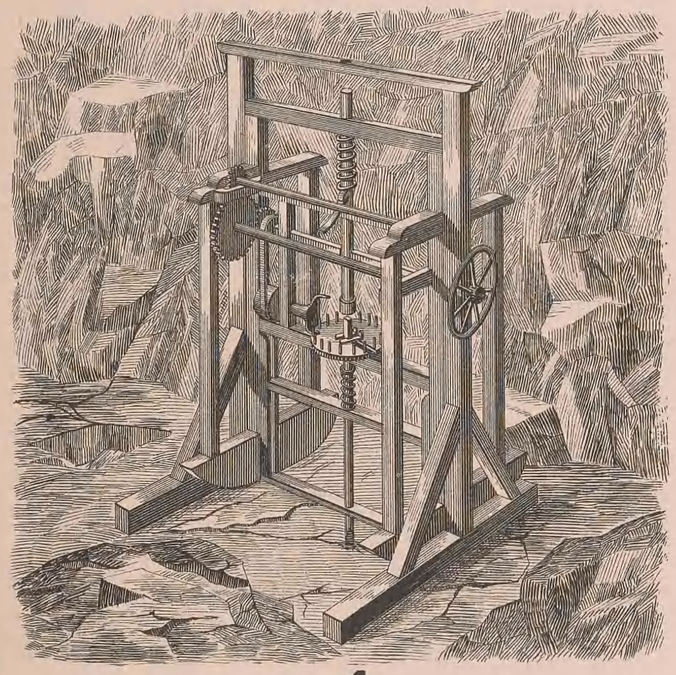
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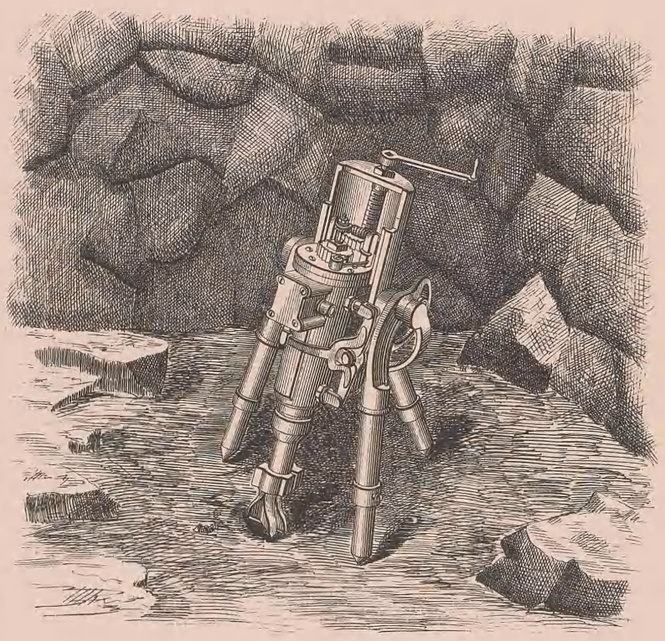
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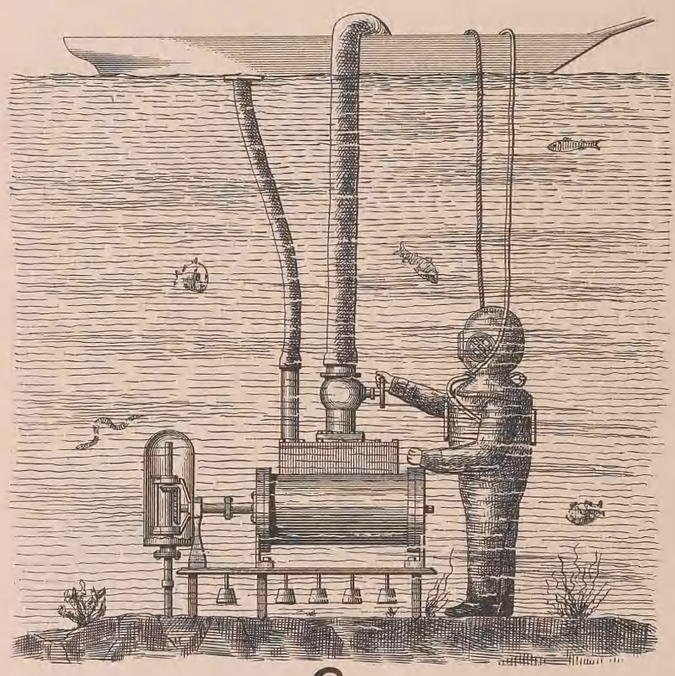
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ROCK DRILLING.

ROCK DRILLING.

No. 1. Primitive Stone Working.
2. " " Drilling.
3. U. S. Patent, Stone Drilling Machine—A. D. 1850.
4. " " " " " —A. D. 1868.
5. " " " " " —A. D. 1871.
6. " " Submarine Rock Drill—A. D. 1876.
7. " " " Drilling—A. D. 1879.
8. " " Steam Rock Drill—A. D. 1880.
9. " " Compressed Air Drill—A. D. 1880.

It has been surmised that the use of the "diamond" for rock boring and cutting was known to the ancients. By referring to ancient writers, we find that diamonds formed an important adjunct to the "Hewers of stone" as well as the lapidary.

Martin Weigel, mine superintendent of Freiberg, proposed drilling and blasting in mining in 1613.

It is said that prior to 1673 but one hand drilling machine had been introduced.

In 1724 drilling and blasting were introduced into Sweden by German miners.

For a period of one hundred and thirty-six years prior to 1749, all drilling had been done by means of crown and hand drills. In this year Hungarian miners first introduced the chisel bit and drill.

In 1813, Richard Trevethick, the distinguished English engineer, is said to have suggested rock drilling by machinery.

In 1849, J. J. Crouch, of Philadelphia, Pa., patented the first percussion rock drill.

Among the most noted of modern rock drills, and the principal one employed in excavating the Hoosac Tunnel, is the "Burleigh drill." It is what is called a "percussion drill," and is usually propelled by compressed air.

The Ingersoll drill is especially effective in excavating in open cuts.

The American diamond drill is a revolving tool which is driven by steam or compressed air. This drill is much used in deep boring, and was used by the United States Government in deepening the channel of the James River below Richmond, Virginia.

By the use of the pneumatic drill the Mount Cenis Tunnel, seven miles in length, was bored through the Alps.

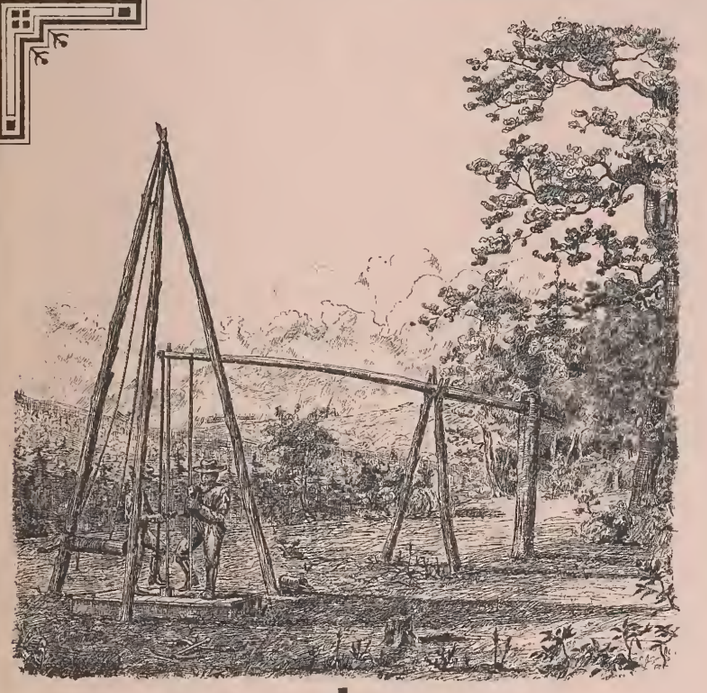
The Hoosac tunnel in Mass., five miles in length, was cut by the same means.

Compressed air was also used in the St. Gothard tunnel in Switzerland, also in the operations at Hell Gate, East River, New York.

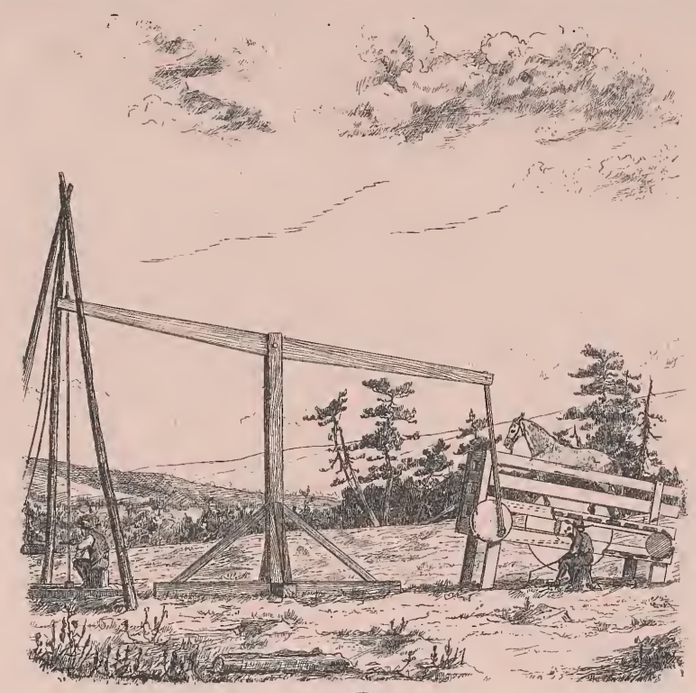
ROCK DRILLING.

713 Patents Granted by the United States.

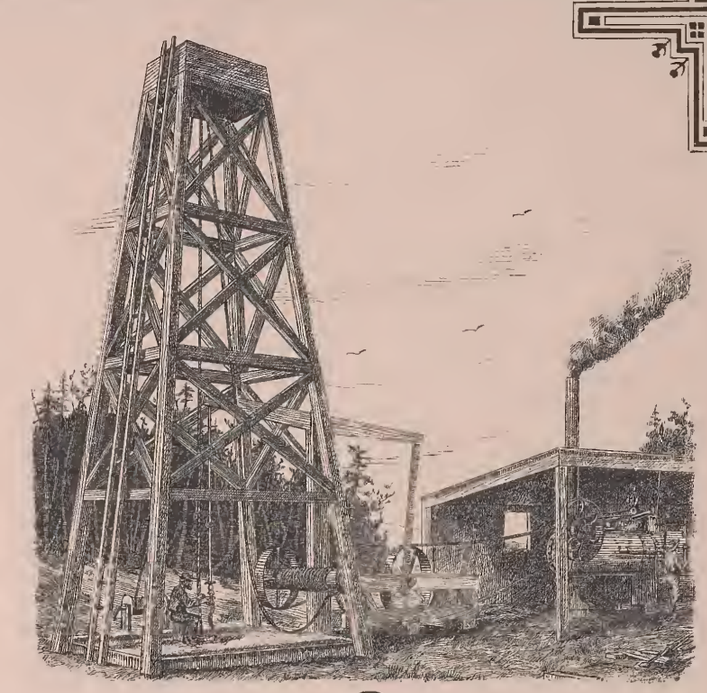
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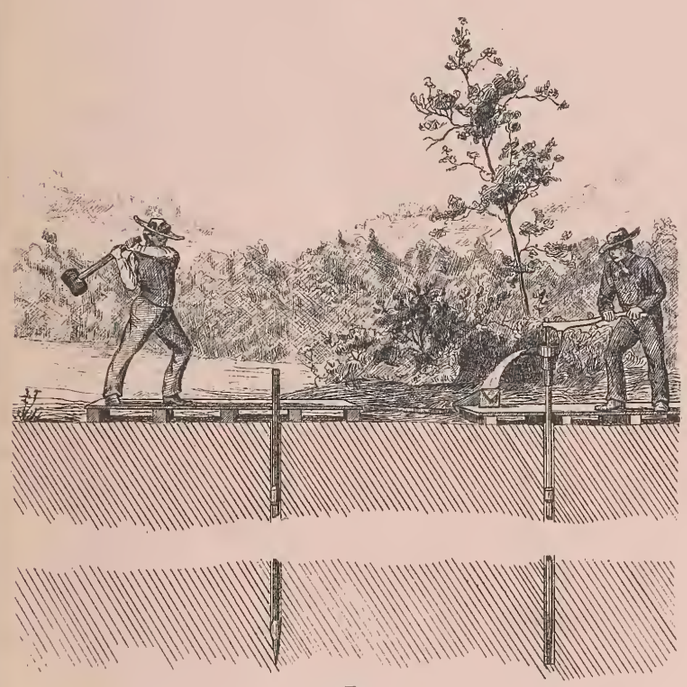
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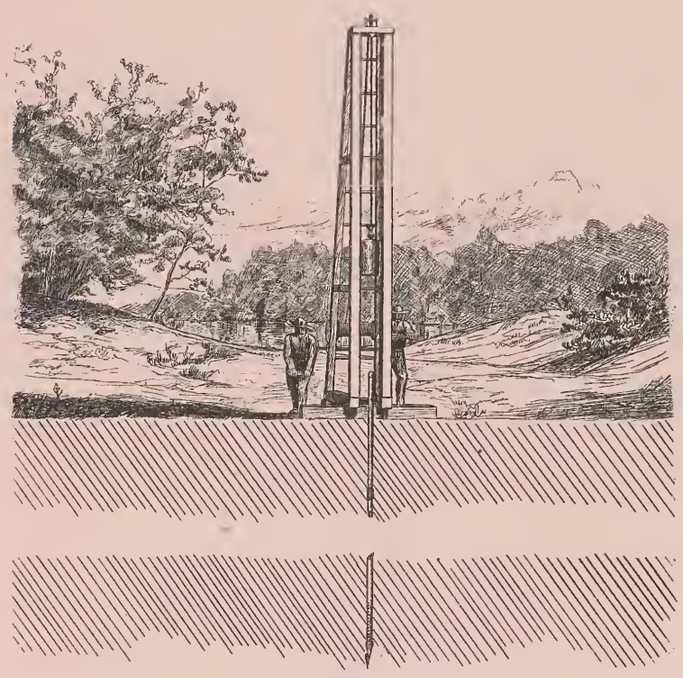
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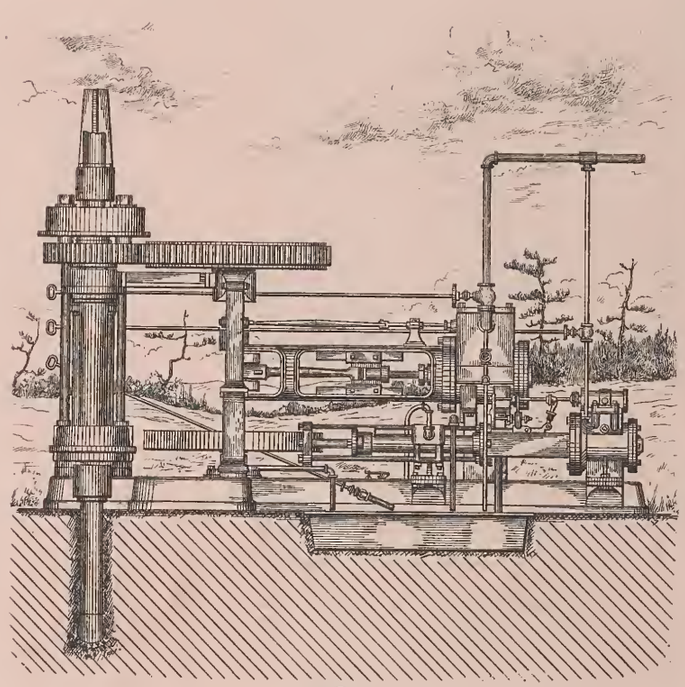
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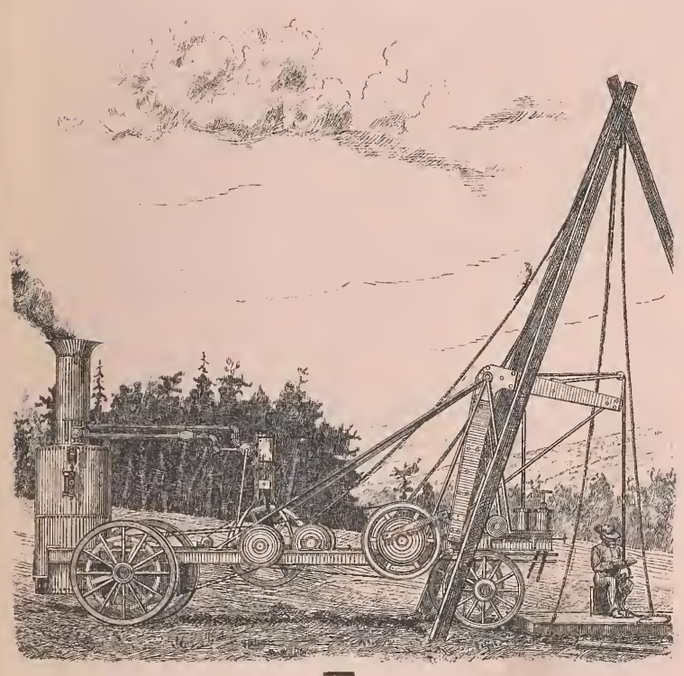
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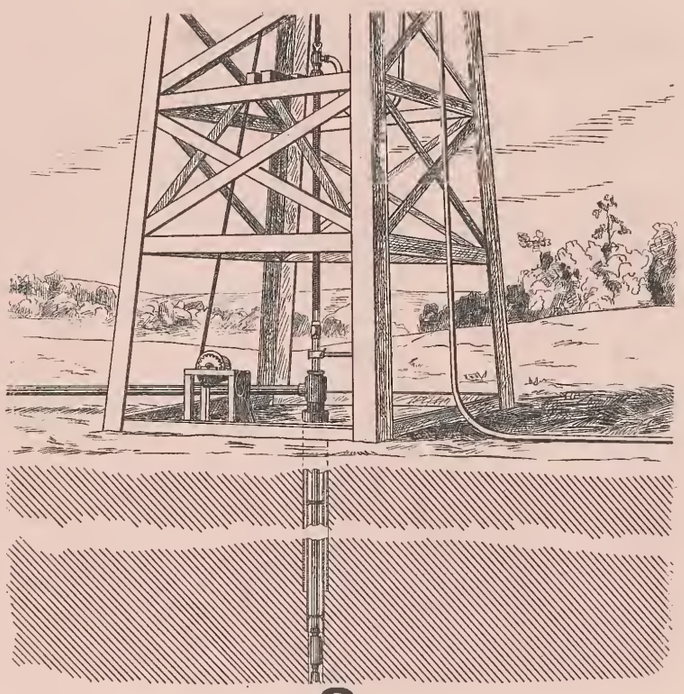
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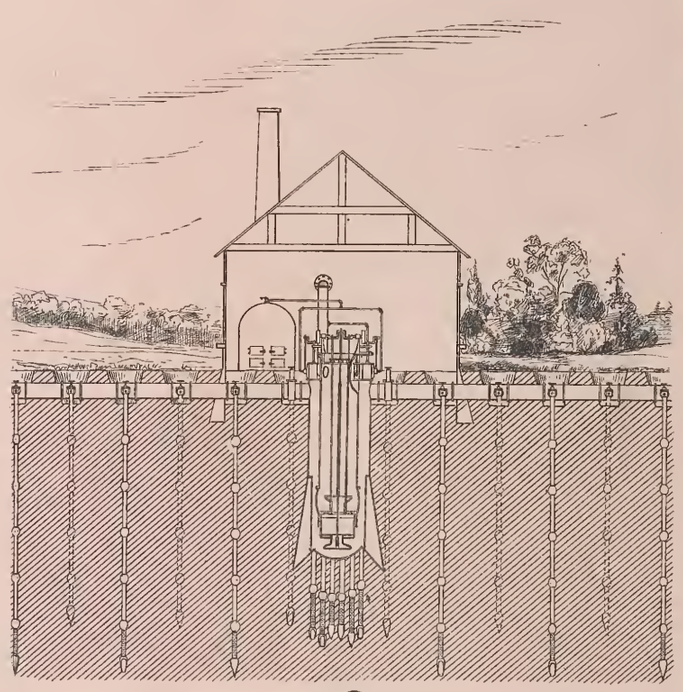
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WELL BORING AND DRILLING.

WELL BORING AND DRILLING.

1. Primitive, Well Drilling.
2. " Horse Power Drilling.
3. Steam Power Drilling.
4. U. S. Patent, Hand Driving Wells—A. D. 1868.
5. " " Pile Driving Wells—A. D. 1868.
6. " " Rotary Diamond Drilling—A. D. 1881.
7. " " Portable Steam Drilling—A. D. 1884.
8. " " Hydraulic Drilling—A. D. 1884.
9. " " Driven Well System for Cities—A. D. 1884

Jacob's well, at Sychar, was 9 feet in diameter, 105 feet deep, and was made entirely through solid rock.

The well of Joseph, at Cairo, is the most remarkable work of its kind. It is excavated in the solid rock, with a section 18 x 14 feet, to the depth of 165 feet, where an enlarged chamber is found, in which is cut a reservoir for the water brought up from below. From the front, another shaft, not in the same vertical line with the upper one, is sunk to a further depth of 130 feet, when a bed of gravel is reached, from which the water is obtained. The total depth is 297 feet.

The Chinese mode of boring wells has been practiced in that country from the earliest time. Some of these wells are from 1,500 to 1,800 feet deep, and from five to six inches in diameter.

Artesian wells were first introduced in the province of Artois, France.

The artesian well at Kissengen, Bavaria, was begun in 1832. In 1850 water was reached at a depth of 1,878 feet.

The artesian wells at Chicago, United States, are 700 feet deep, and discharge 1,250,000 gallons daily.

Petroleum in any vast quantity was unknown in the United States until 1845, when oil was obtained while boring for salt near Pittsburgh, Pa.

In August, 1859, operations were commenced at Titusville, Pa., by boring. At the depth of 71 feet, a fountain was reached which yielded about 1,000 gallons daily.

Before the close of the year 1860, the number of borings and wells was estimated to be about 2,000.

In May, 1856, the work of boring wells in the Desert of Sahara was commenced. Water was reached June 19th, and 1,060 gallons per minute were discharged, of a temperature of 79 degrees Fah.

Several wells in the United States bored for oil have developed fine flows of mineral water.

One of the most celebrated artesian wells is at Grenelle, near Paris, France. It took seven years to complete it. It is 1,802 feet deep. When the water bearing strata were reached, the water was discharged at the rate of 880,000 gallons in twenty-four hours, and the force was so great that water was carried 120 feet above the surface.

The deepest well in the world is said to be near Berlin, Germany. Its depth is 4,170 feet.

The invention of the drive well was made in 1861 by Nelson W. Green, an officer of a New York regiment, during the late civil war. He conceived the idea of driving into the earth small tubes of iron perforated at the bottom, and of attaching a pump at the upper end of the tube. His invention was adopted for the use of the United States army. Its use quickly spread to foreign countries, and it is now an adjunct of the military equipment of all nations, and is common throughout the world.

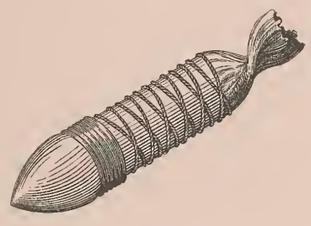
2,890 petroleum wells were put down in 1883.

WELL BORING AND DRILLING.

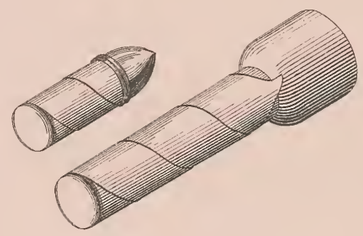
CAPACITY—	Primitive Mode.	Present Machine.
Feet Drilled per day, . .	6	50
Hands Employed per day, . .	2	2

791 Patents Granted by the United States.

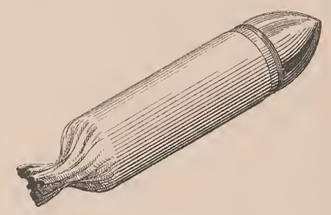
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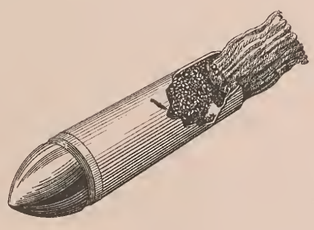
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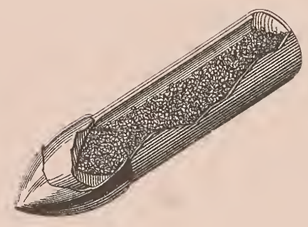
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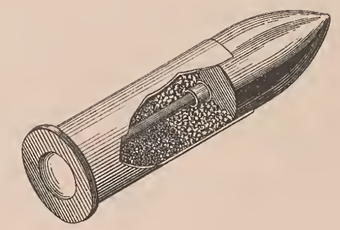
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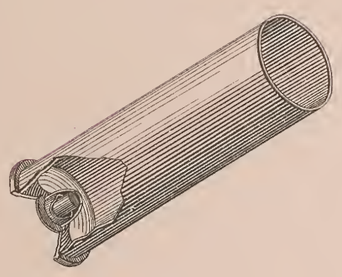
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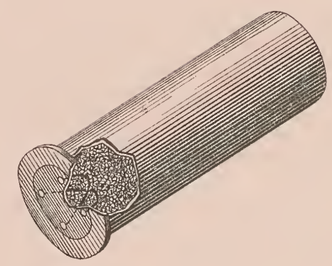
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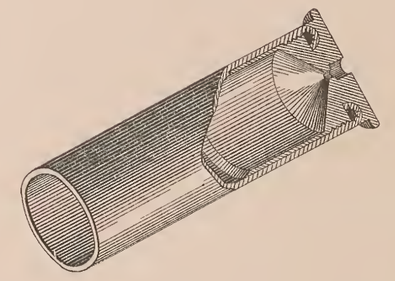
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CARTRIDGES.

CARTRIDGES.

No. 1. U. S. Patent, Paper—A. D. 1858.
2. " " Gut—A. D. 1862.
3. " " Outer Paper Case—A. D. 1862.
4. " " Fibrous Stopper—A. D. 1863.
5. " " Charged—A. D. 1863.
6. " " Interior Fire—A. D. 1866.
7. " " Paper Reinforced—A. D. 1869.
8. " " Electric—A. D. 1883.
9. " " Paper Shell and Metal Base—A. D. 1884.

Cartridges are of modern invention. The original custom was to use loose powder and ball. Gustavus Adolphus in 1632 made up the first cartridge with a measured quantity of powder and ball attached. Sir James Turner, in the time of Charles II of England, speaks of cartridges used by horsemen carried in a patron. Subsequently cartridges were carried in cases suspended from bandoliers. Still later the cartridge box was adopted, and in modified form is still in use.

Round ball and buck, and ball cartridge are now out of use. They were made of a paper cylinder, which was partially filled with powder and choked near its mid-length by twine, the powder occupying one end and the ball the other; Colt covered his cartridges with tinfoil, and afterwards with paper saturated with nitrate of potassa. The American process of drawing out the blanks for metallic cartridge cases into tubes has been adopted in the European service. The use of metal for this purpose originated with the French. In 1826 Cazalt patented a cartridge of this kind; one of the earliest cartridges was patented by Roberts, of Paris, in 1834. Smith & Wesson took out patents in 1854 and 1860. The fulminate in the first of these was contained in a capsule at the base, in the latter in an annulus within the flange surrounding the base of the cartridge, secured in place by a pasteboard disk.

The metallic cartridge is generally in use throughout the United States and Europe.

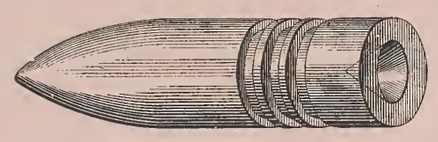
CARTRIDGES.

311 Patents Granted by the United States.

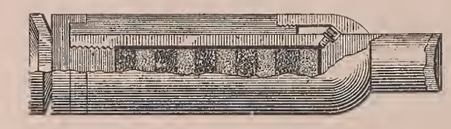
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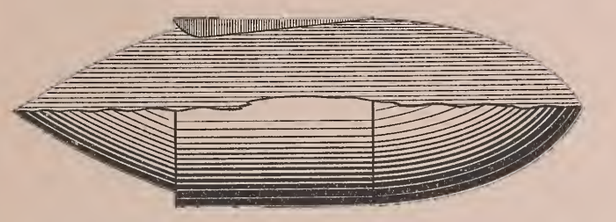
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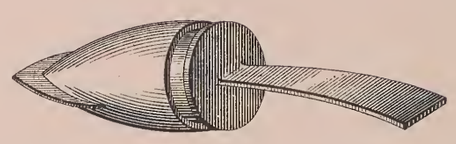


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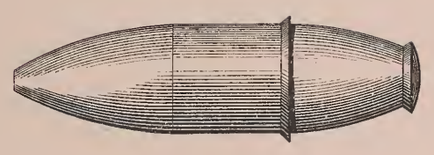


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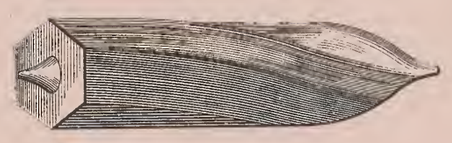
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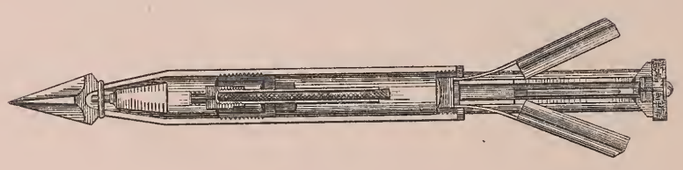
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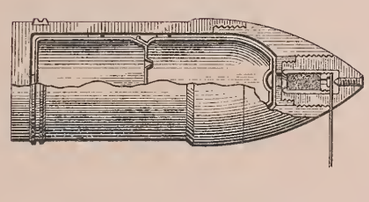
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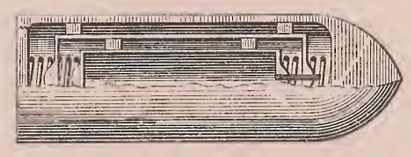
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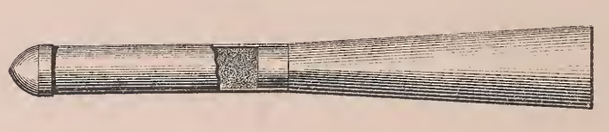
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PROJECTILES.

PROJECTILES.

No. 1. Primitive Round Musket Ball.
2. Minie Ball.
3. U. S. Patent, Projectile—A. D. 1847.
4. " " Ellipsoidal—A. D. 1863.
5. " " Nitroleum and Gun Cotton—A. D. 1866
6. " " Tailco—A. D. 1870.
7 " " Projectile—A. D. 1876.
8. " " Rifled Projectile—A. D 1879.
9. " " Bomb Lance—A. D. 1879.
10. " " Fragile Inner Case Projectile—A. D. 1883.
11. " " Dynamite Shell—A. D. 1884.
12. " " " Projectile—A. D. 1884.

Projectiles are missiles thrown from a gun by the expansive force of air, gas, or steam. Stones were formerly used as projectiles for cannons.

Balls of copper were used in South America.

Henry VIII, A. D. 1418, issued an order to his clerk of ordnance for making stone balls for his cannons of various sizes. The use of stone was not abandoned in England until the time of Charles I.

The French used iron balls toward the close of the fourteenth century.

English historians do not mention their use until 1550.

Attempts were made to ascertain the velocity of projectiles as early as 1740.

The Turks used stone as late as 1827.

Elongated bullets for rifled cannon, termed by the English, "bolts," are made angularly pointed to perforate iron plating.

Shells are hollow projectiles.

Case shot are thinner than shells.

Grenades are small shells thrown by the hand. In the French army the right company of each battalion was formerly composed of the tallest men, armed with hand grenades, hence the term "grenadiers."

The Orsini grenades, with which an attempt was made to assassinate Louis Napoleon, are said to be an English invention.

The most prominent makes of shell used by the United States during the late war were the Parrott, Hotchkiss, and Shrapnel.

At the present time cast iron is universally used for cannon balls.

By the use of the Schultz chronoscope the intervals of time of projectiles can be measured from 30 seconds to 1-5,000 part of a second.

Guns have been tested at Sandy Hook, in the course of experiments, up to a pressure of 107,000 pounds per square inch. The average pressure on a gun was 40,000 pounds to the square inch.

The velocity of projectiles from large guns ranged from 600 to 2,400 feet per second.

PROJECTILES.

1,028 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



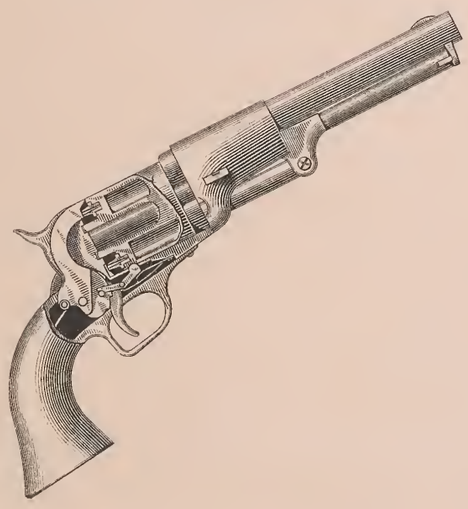
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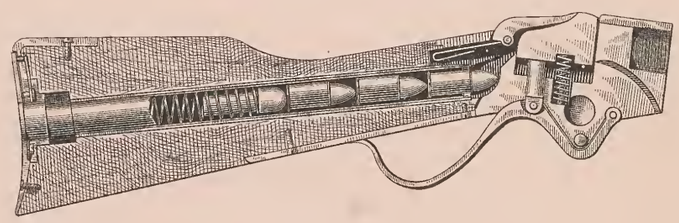
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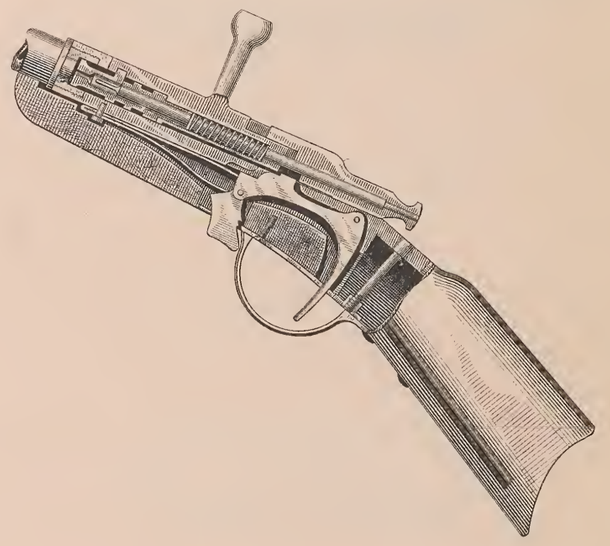
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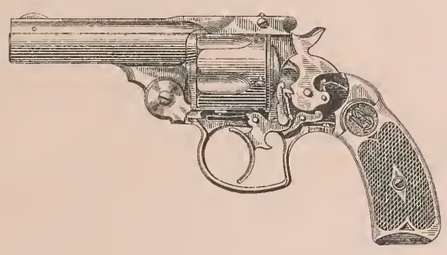
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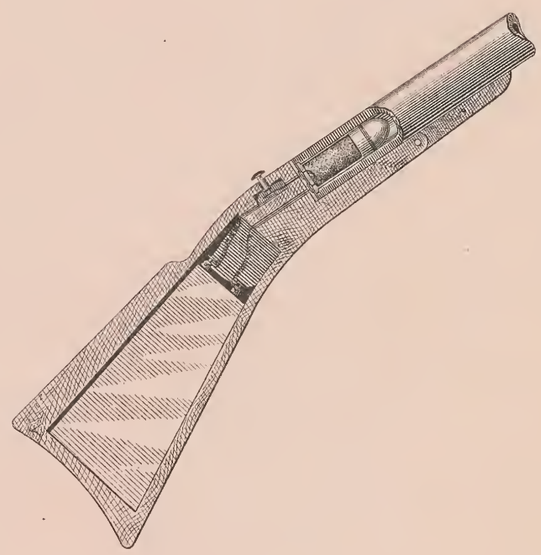
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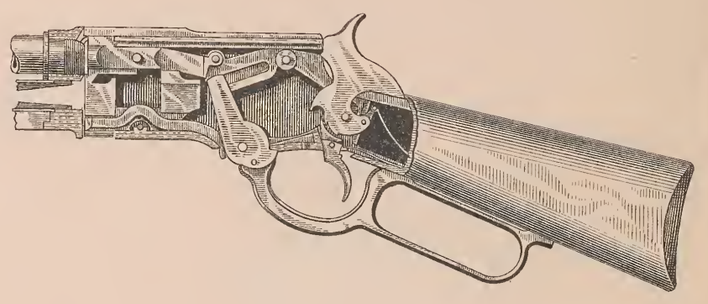
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9

FIRE ARMS.

FIRE ARMS.

No. 1. German Flint Lock Pistol, 16th Century
2. Match Lock, 16th Century.
3. Muzzle Loader, 19th Century.
4. U. S. Patent, Revolver—A. D. 1850.
5. " " Magazine Gun—A. D. 1865.
6. " " Breech Loader—A. D. 1875.
7. " " Revolver—A. D. 1882.
8. " " Electric Gun—A. D 1883.
9. " " Breech Loader—A D. 1884.

The invention of Portable Fire Arms is attributed to the Italians, and the year 1430 has been named as the time of their introduction. The earliest record of their introduction into England is in 1471, when Edward IV landed at Ravenspur with 900 Flemings, armed with hand guns.

The Dutch invented the apparatus for striking fire by the friction of a small steel wheel against a piece of iron pyrites. This was known as the wheel lock.

The flint lock was introduced during the reign of Queen Elizabeth, about 1692, and was superseded by the percussion lock in 1807.

An interesting model, showing the revolving cylinder of a fire arm (upon which the Colt's principle of the Colt revolver is based,) is to be seen in the Museum at the Washington Navy Yard, such model having been presented by the British Government, and is said to have been made during the reign of Queen Elizabeth.

Henry VIII, of England, took great interest in fire arms, and two weapons made during his reign are still in existence, and are said to resemble the modern Snider rifle.

Among the curiosities of this branch of invention is Pickles' English Patent of 1718, wherein is described the use of "round bullets for Christians and square ones for Turks."

The first U. S. patent granted for a breech loader was to Thornton and Hall, May 21st, 1811. Between that time and 1839 over 10,000 of these arms were made and issued to the troops in garrison on the frontier.

Prior to the war of 1861--65 the principal breech loaders were known as Sharps, Burnside, Maynards, Merrills and Spencers.

The Martini gun was invented by a Swiss.

The Chassepot is a French invention.

The United States has adopted the Springfield pattern of gun, manufactured at the Springfield Arsenal, Mass., after the systems of Allen and of Stillman; England the Snider improved; France the Chassepot; Belgium the Albini; Holland the Snyder; Austria the Wanzel; Turkey the Remington and Winchester; Sweden the Hagstorm; Russia the Laidley and Berdan; Switzerland the Winchester; Portugal the Westley Richards; Prussia the Needle Gun.

Breech loaders purchased by the United States between 1861 and 1866 were of the following kinds and numbers of each: Spencer, 94,156; Sharps, 80,512; Burnside, 55,567; Smith, 30,062; Starr, 25,603; Gallaher, 22,728; Maynard, 20,002; Remington, 20,000; Merrill, 14,495; Joslyn, 11,261; Cosmopolitan, 9,342; Warner, 4,001; Hall, 3,520; Gibbs, 1,052; Ballard, 1,500; Ball, 1,002; Palmer, 1,001; Snyder, 892; Wesson, 151.

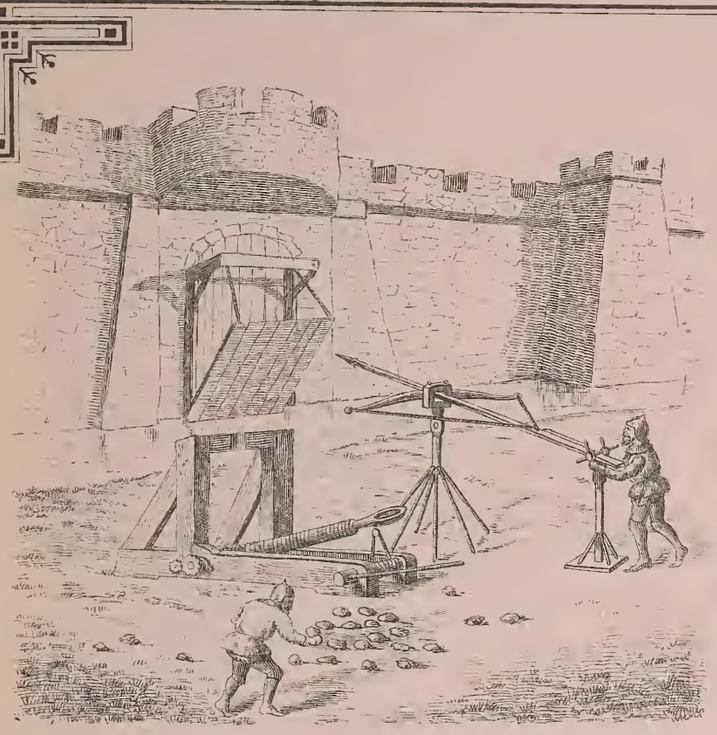
FIRE ARMS.

39 Manufactories in the United States.

	1860	1880
Capital Invested,	$466,000.00	$8,115,489.00
Value of Productions,	891,344.00	5,736,936.00
Wages Paid,	95,016.00	2,700,281.00
Hands Employed,	308	4,672

2,446 Patents Granted by the United States.

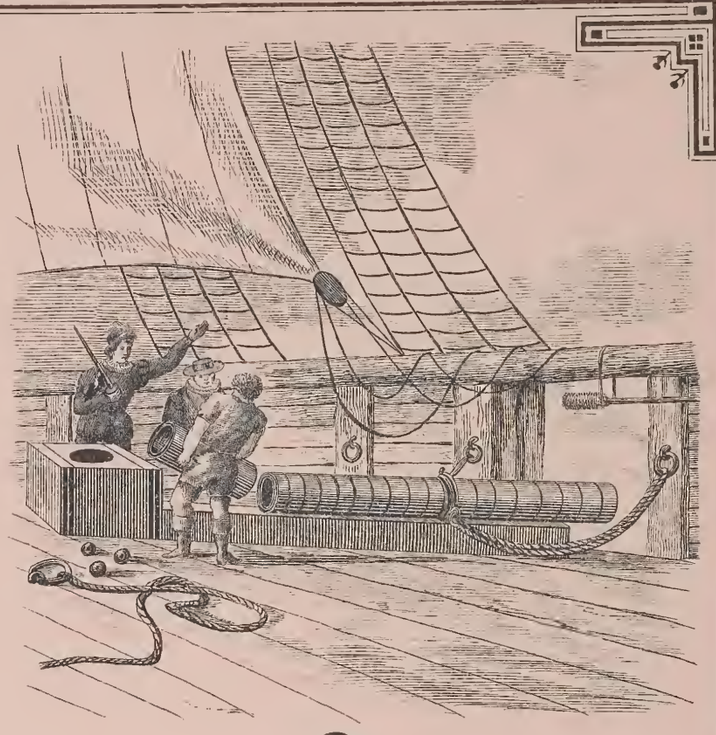
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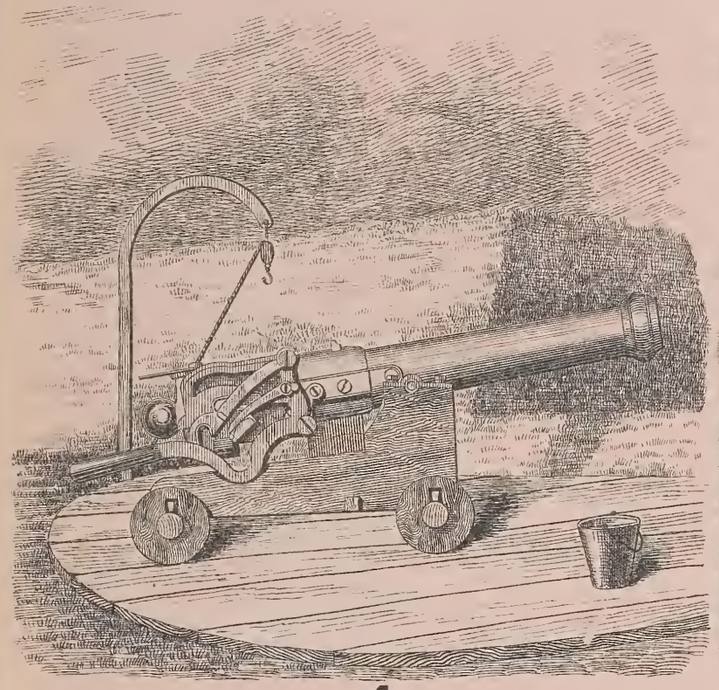
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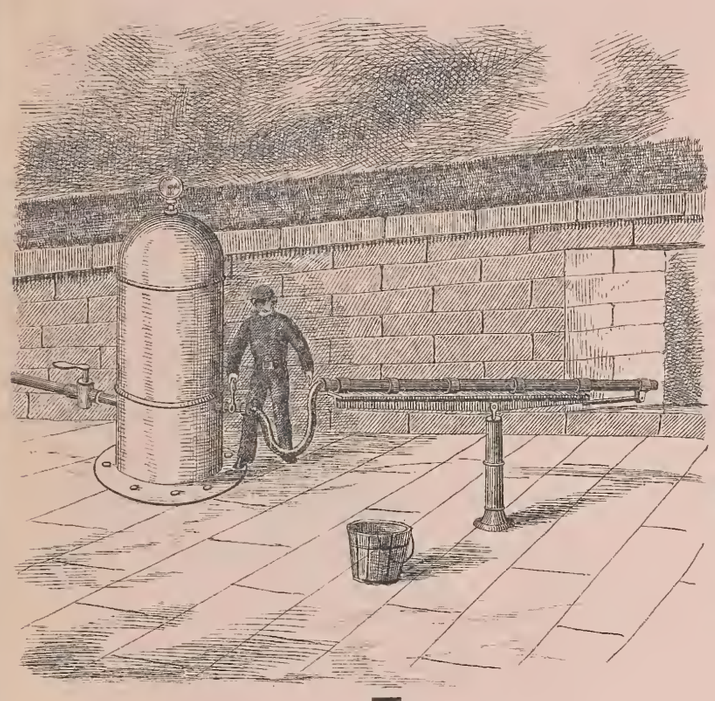
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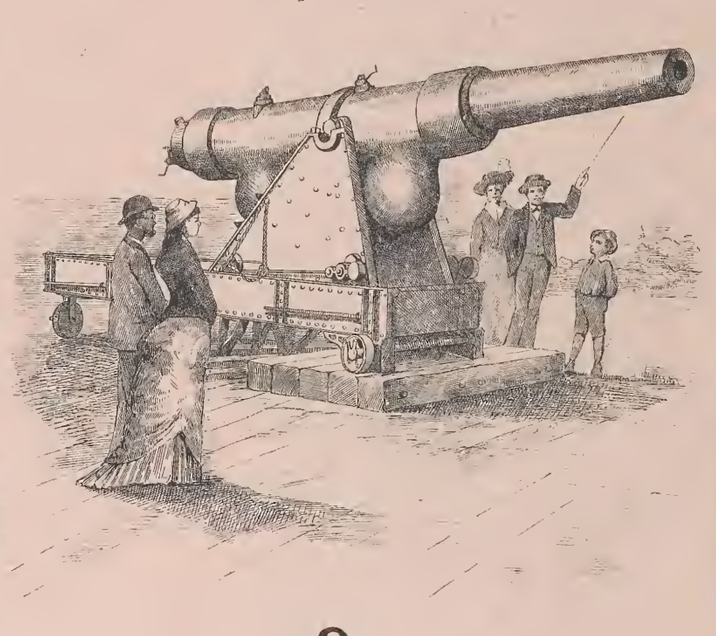
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ORDNANCE.

ORDNANCE.

No. 1. Primitive Greek Catapult.
2. Muzzle Loader, "Mons. Meg," 16th Century.
3. Breech Loader, "Mary Ross,"—A. D. 1545.
4. U. S. Patent, Breech Loader—A. D. 1853.
5. " " Machine Gun—A. D. 1872.
6. " " " " —A. D. 1879.
7. " " Pneumatic Gun—A. D. 1883
8. " " Machine Gun—A. D. 1884.
9. " " Multicharge Gun—A. D. 1884.

Cannon were doubtless invented by the Chinese. They were used in Spain as early as 1118.

In the eleventh century, Alphonso VI says: "The vessels of the King of Tunis, in the attack on Saville, had on board iron pipes, out of which volumes of thundering fire were discharged."

No mention is made of cannon in Hindoo books till the 13th century, but during the next hundred years they were in general use throughout India.

Ferdinand took Gibraltar from the Moors, by the aid of cannon, in 1309.

Prior to the 15th century cannon were made by welding bars of iron longitudinally, and binding them by rings, which were shrunk on over them while hot. Some of the ancient guns were breech loaders.

James II, of Scotland, met his death in 1460 by the bursting of a hooped gun.

The first mortar was made in England, in 1543.

Frederick the Great made extensive use of howitzers.

In 1818, Col. Bomford, of the U. S. army, introduced a chambered gun, called "the Columbiad." This was modified, in 1822, by Col. Paixhans, of the French army.

About 1847, Gen Rodman developed his theory of initial tension, and in 1850 Admiral Dahlgren proposed a new system of casting guns nearly cylindrical, and turning down to the required shape.

In 1850, Louis Napoleon devised a light cannon, known as the "gun-howitzer, or Napoleon gun." It was successfully used in the Crimean war, and was adopted into the United States and several European services.

The first Armstrong gun was made in 1855, and patented in 1857.

Whitworth commenced his experiments in 1855.

The Armstrong and Whitworth are the most celebrated English guns.

Mallet constructed a mortar, in 1857, which took a charge of powder of seventy pounds, and threw a shell weighing 2,550 pounds one and one-half miles longitudinally, and three-quarters of a mile high.

Rifled cannon were first successfully used by Louis Napoleon, in 1859, in his Italian campaign.

The "General James" was the first introduced into the U. S. service, in 1861. The Parrott gun soon followed the James.

Mortars in the U. S. service are divided into three classes, viz: Sea Coast, Siege and Coehorn.

Among the largest mortars known are those in the Island of Malta. Sea coast and siege mortars are of cast iron.

The Krupp breech-loading, rifled cannon were used by Prussia in the last war with Austria, and in the Franco-Prussian war in 1870. Seven hundred and fifty of these guns were used at Sedan.

The Krupp system has been adopted by nearly all the leading European nations, as well as by China and Japan.

Twenty-inch muzzle loading rifle cannon have been made at Krupp's works, at Essen, Prussia, weighing over 120,000 pounds.

Following is a list of the most noted guns and their weights:

"Dulle Griete," of Holland, A. D. 1430, 29,120 pounds; wrought iron gun, Edinborough, A. D. 1460, 12,768 pounds; bronze cannon of Mahommed II, 1464, 41,888 pounds; great bronze gun of Bijapoor, India, 1548, 89,600 pounds; great bronze gun of Moscow, 1586, 86,200 pounds; Mallet's mortar, 1857, 93,840 pounds; English wrought-iron muzzle loader, 48,400 pounds.

The first successful machine gun was invented by Dr. Gatling, an American.

The French mitrailleuse was the first machine gun used in service in the field.

ORDNANCE.

577 Patents Granted by the United States.

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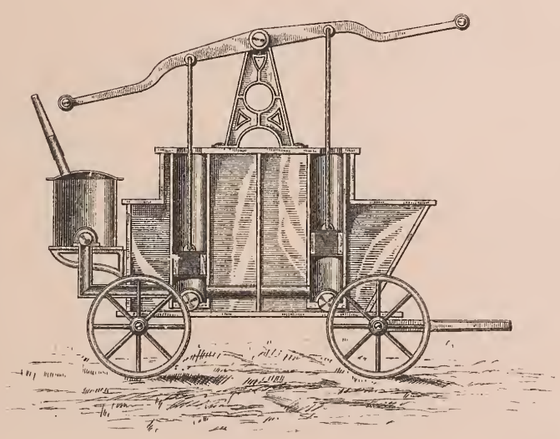
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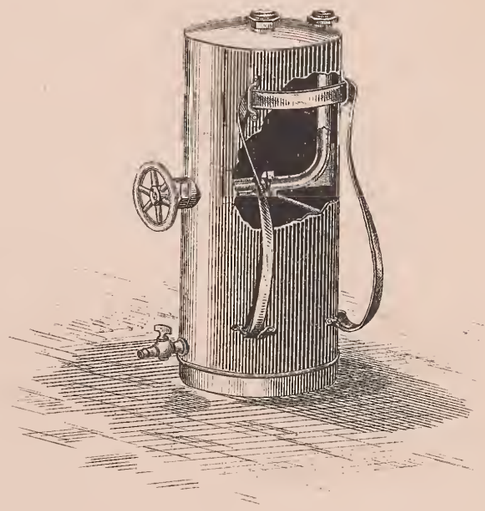
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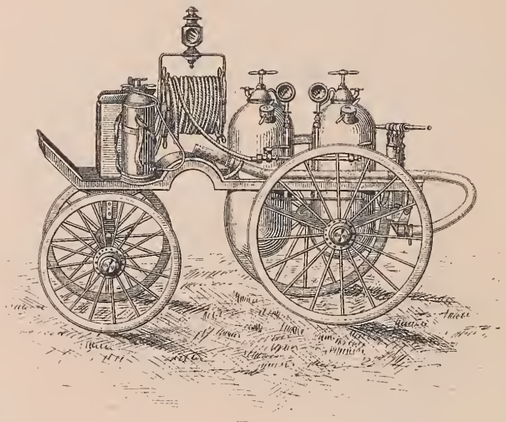
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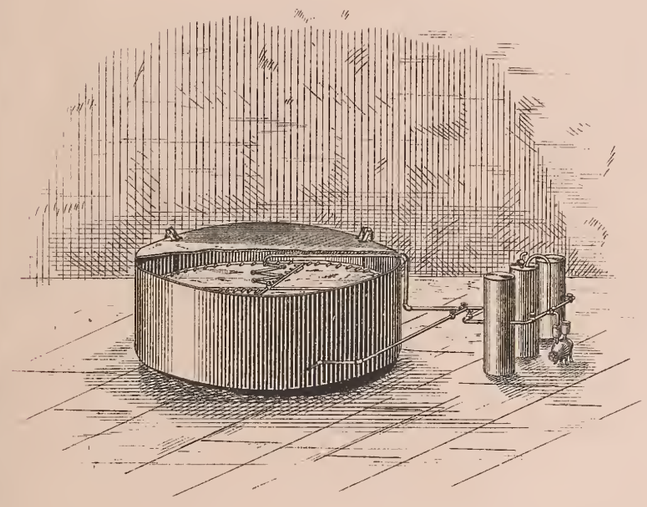
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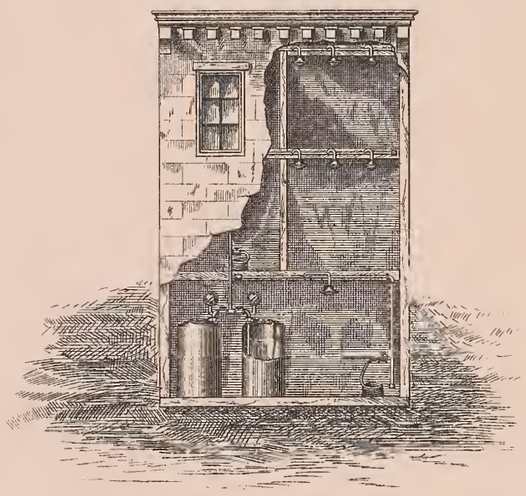
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CHEMICAL FIRE EXTINGUISHERS.

CHEMICAL FIRE EXTINGUISHERS.

No. 1. Bomb Extinguisher—A. D. 1688.
2. " " —A. D. 1693.
3. " " —A. D. 1723.
4. U. S. Patent, Chemical Engine—A. D. 1867.
5. " " Portable Chemical Extinguisher—A. D. 1870.
6. " " Chemical Engine—A. D. 1872.
7. " " Chemical Engine for Oil Tanks—A. D. 1875.
8. " " Chemical Engine for Buildings—A. D. 1881.
9. " " Hand Grenade—A. D. 1884.

Chemical fire extinguishers are portable apparatus for extinguishing fires either by ejection of water, saline solution, or carbonic acid gas. The vessel contains chemicals whose reaction when brought into contact, releases a gas which presses upon the surface of the water and ejects it at the nozzle. The chemicals may be contained in two chambers; inversion of the apparatus or the breaking of a bottle of acid mixes the ingredients, and the chemical reaction evolves a gas which passes upon the water. Chemicals may be mixed in the water and generate the pressure which is immediately available when the nozzle is opened and air admitted. The water is saturated with gas, as in the soda-fountain.

The receptacle has two vessels, one containing an acid, and the other an alkali. In some of these apparatus water is ejected with carbonic acid, whilst others generate sufficient heat to evaporate the water.

Chemicals used are phosphate of lime, nitrate and chlorate of potash, carbon, sulphur, and various other materials in a multitude of combinations.

The devices refer particularly to modes of construction, the acid and alkali chamber, and the manner of precipitating the former upon the latter to gain the desired result.

Phillips, in 1849, patented a fire extinguisher which had a compound of sugar and chlorate of potash, so placed as to receive the contents of a bottle of sulphuric acid which is broken by striking a plug on the top of the can when a fire occurs.

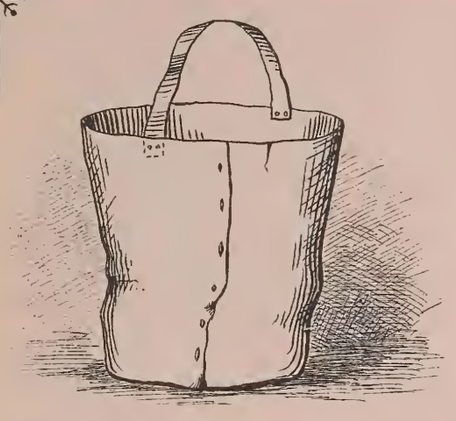
There are numerous fire extinguishers.

The most noted and in use in the United States are the American, National, Babcock, and the Harden Hand Grenade.

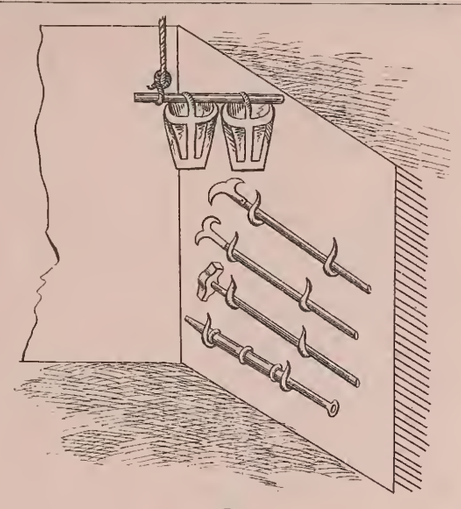
CHEMICAL FIRE EXTINGUISHERS.

250 Patents Granted by the United States.

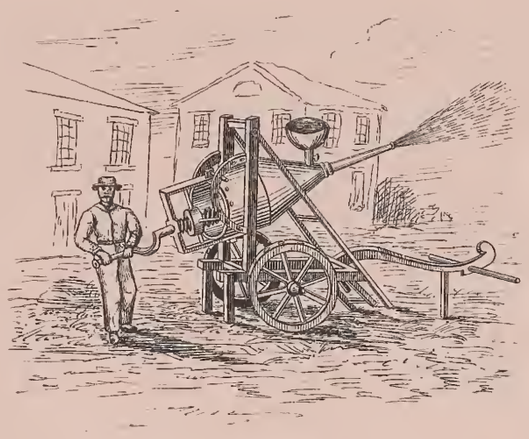
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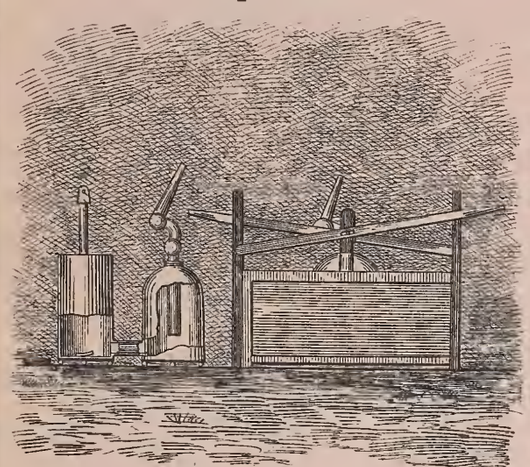
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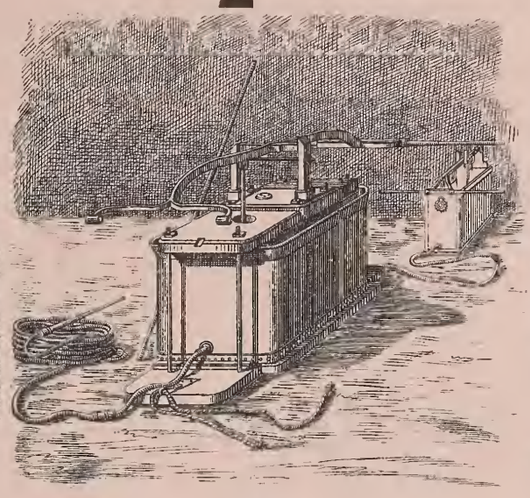
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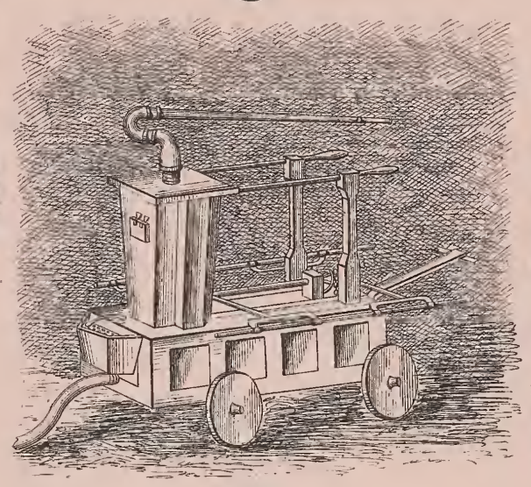
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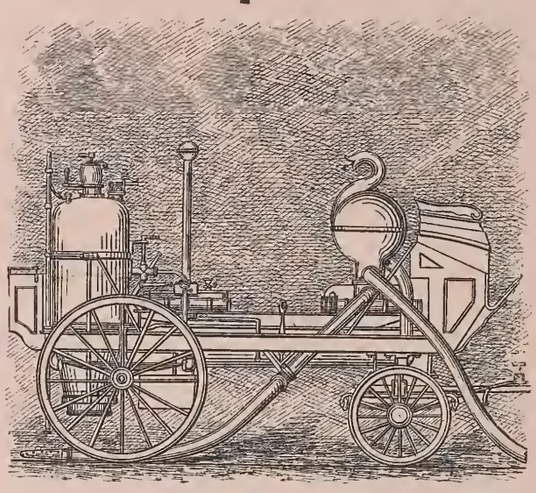
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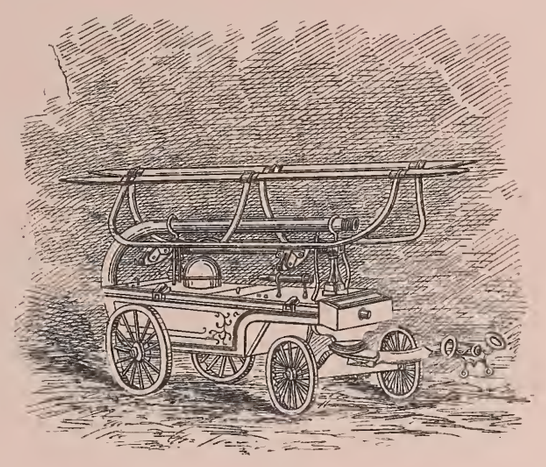
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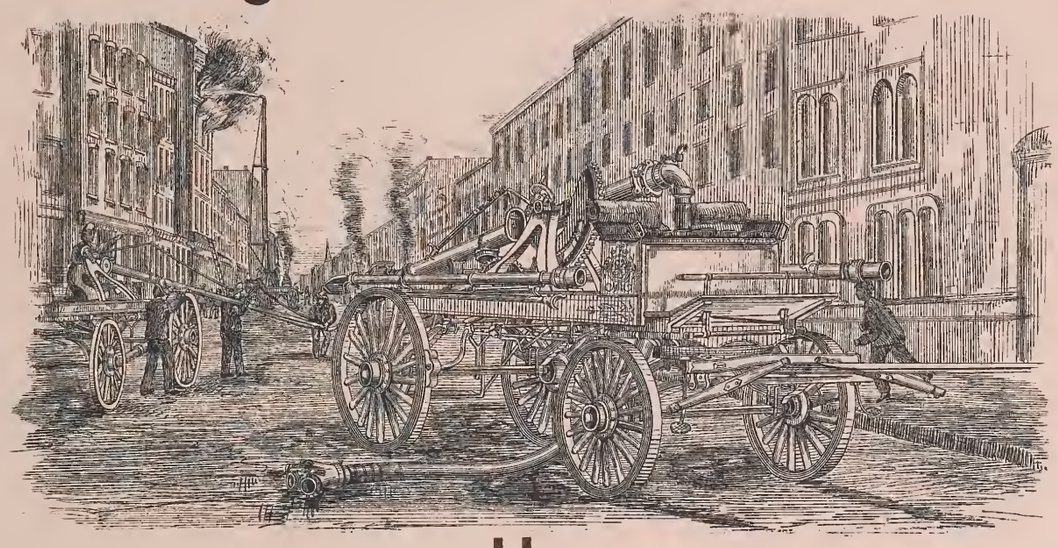
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12

FIRE ENGINES.

FIRE ENGINES.

No. 1. Primitive Water Bucket.
2. " Fire Syringe, Buckets, &c., 2d and 3d Centuries.
3. " " —A. D. 1568.
4. " Single Acting Pump—A. D. 1600.
5. " Air Chamber Engine—A. D. 1633.
6. " Detachable Section Hose—A. D. 1672.
7. Hand Fire Engine—A. D. 1725.
8. Steam " " —A. D. 1829.
9. U. S. Patent, Hand Fire Engine—A. D. 1834.
10. " " Steam " " —A. D. 1868.
11. " " Water Tower—A. D. 1880.
12. " " Horse Power—A. D. 1882.

The oldest known Engine is that of Herod, 150 B. C., and from the description it might stand for the ordinary form of hand engine used in modern times. The engine had two single acting pumps worked by one beam by means of brakes. The streams united in a common discharge pipe passing up a trunk in which was an air chamber and out at a nozzle which was capable of being presented in any direction.

The Fire Brigade of Imperial Rome consisted of six hundred firemen, organized by Cæsar 732 B. C.

The "Sipho" of the Romans is referred to by Pliny. Strabo alludes to the siphons which were kept in houses in preparation for accidental fires; frequent references are made to this device, but its construction seems to be unknown.

Appolodonus recommended a leather bag containing water, with hollow cones for nozzles.

The first notice of the fire engine in modern times is that of the Water Syringe, which was in use in 1518. It was mounted on wheels and worked by levers.

The fire engines of Nuremberg were mounted on sleds four by ten feet, and drawn by two horses; they had cisterns two by eight feet deep, in which were two horizontal cylinders; the brakes were worked by twenty-eight men, and the combining streams from the cylinder issued at a one-inch orifice and reached the height of eighty feet.

Thomas Grant obtained an English patent in 1632.

Van DerHeyden, of Amsterdam, is credited with having brought the machine in 1663 to the present form of hand engine.

Leathern Hose in detachable sections was invented by the brothers Van DerHeyden in 1670.

Hooks and fire ladders came into historic notice about 1699, although it must be assumed that they were long before in use.

Fire plugs were first introduced in the streets of London in 1710.

Towards the close of the seventeenth century the double cylinder portable pump with air chamber was introduced into England by Newsham. The application of steam power to work fire engines was first attempted in 1830. The Newsham engine was improved from time to time, and was still used in London in 1832.

Steam power for extinguishing fires was in use in manufactories many years before it was employed on portable machines.

Captain Ericsson built and exhibited a portable steam fire engine in London about the year 1830. In 1841 a steam fire engine was built in New York City; its great weight, however, proved to be a fatal objection to its use. In 1842 or 1843 Capt. Ericsson produced an engine in New York which was tested, but not brought into regular service, it delivered nine thousand gallons of water an hour, to a height of ninety feet, through a seven-eighth-inch nozzle.

The city of Cincinnati, Ohio, was the first to adopt steamers as a permanent portion of its fire department. These engines, and its system, have been copied in the principal cities of the world. The steamer "Citizens' Gift" was built in 1853, and in 1866 gave the following record: time of raising steam, three minutes and forty seconds; size of nozzle, one and one-half inch; distance thrown, three hundred and ten feet, measuring from the end of the nozzle to the place where solid water fell; size of steam cylinder, ten inches bore, twenty-four inches stroke; pump, six inches bore, twenty-four inches stroke; length of hose, one hundred feet; steam, one hundred pounds to square inch; pressure on water cylinder, two hundred and forty pounds to square inch; speed of engine, one hundred and ten revolutions, two hundred and twenty strokes of pumps; grate surface, sixteen feet; heating surface, five hundred and sixty feet.

The Metropolitan Fire Department of New York City numbers thirty-four steamers, of about fifty horse power each. Five hundred and fifty men are employed, including the twelve hook and ladder companies.

Among the best known steam fire engines of the present day are the Amoskeag, Silsby, Clapp & Jones, and Gould.

FIRE ENGINES.

MARINE FIRE BOATS.

Capacity—	Present Machine.
Gallons Water per minute,	3,600
Distance Thrown, feet,	260
Size Jet, inches,	2 to 3
Hands Employed,	12

LAND ENGINES.

Gallons Water per minute,	800
Distance Thrown, feet,	275
Size Jet, inches,	1¼
Hands Employed,	2

Three men with one pair of horses and engine, therefore, do more work than one hundred men by manual power.

621 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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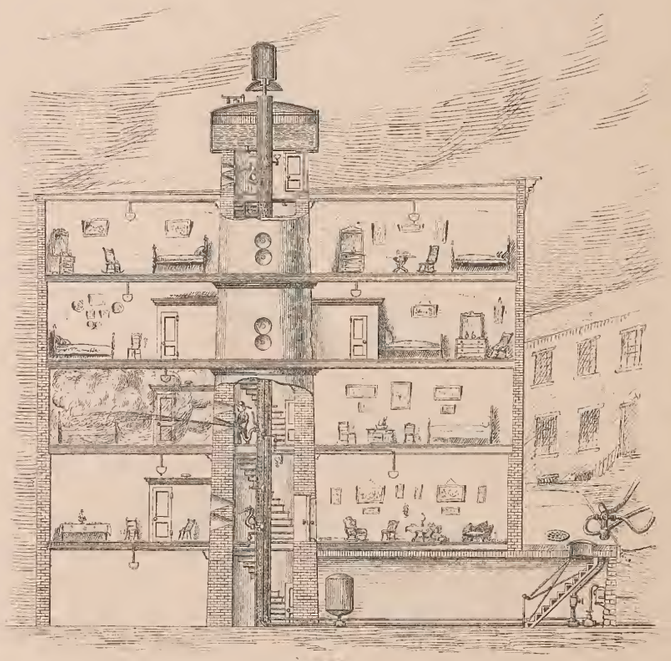
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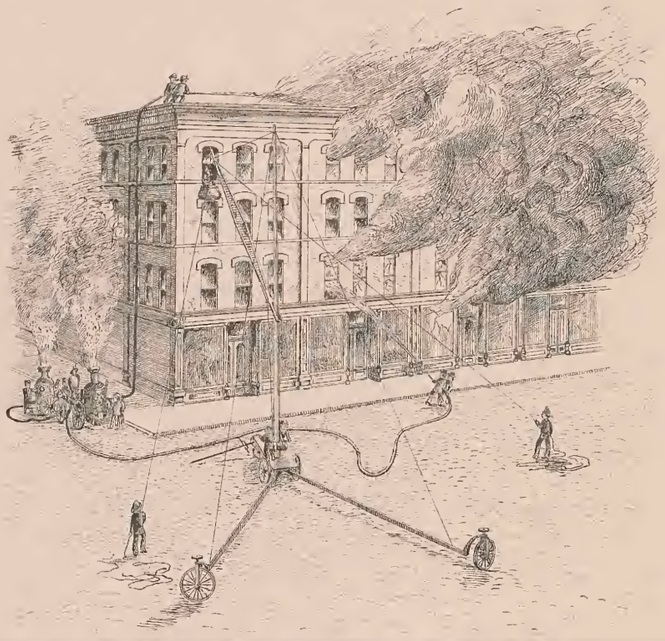
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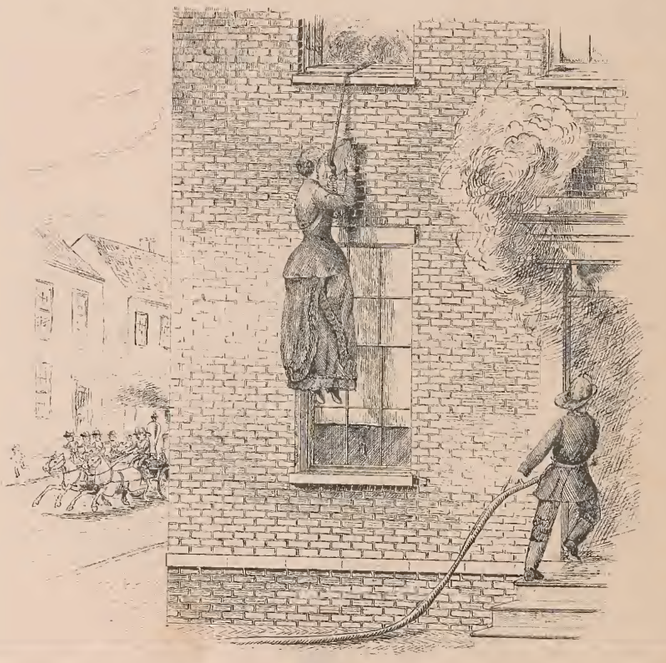
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FIRE ESCAPES.

FIRE ESCAPES.

No. 1. English Hoist—A. D. 1767.
2. " Balcony—A. D. 1791.
3. " Lazy Tongs—A. D. 1840.
4. U. S. Patent, Escape Ladder—A. D. 1857
5. " " Hoist—A. D. 1868.
6. " " Tower—A. D. 1878.
7. " " Hoist—A. D. 1883.
8. " " Escape Ladder—A. D. 1884.
9. " " Portable Friction—A D. 1884

In 1784, Daniel Maseres, of England, invented a machine called a fire escape, which, being fastened to the window, would enable anyone to descend to the street without injury.

Fire escapes have been constructed of many forms, and of every possible material, from iron ladders attached to windows, down the heated rungs of which frightened women are expected to escape, to canvas chutes, down which excited firemen are to shoot them, or ropes, with hooks and loops, in which persons are to tie or hang, and lower themselves from the burning buildings.

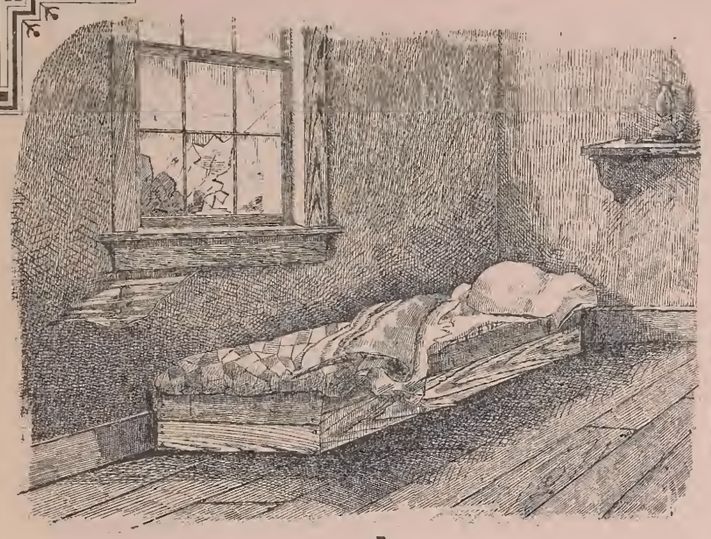
There are portable ladders, to be carried in trunks and satchels; nets fastened upon poles, to be hoisted up to windows, and others for persons to jump into. Some of these may be useful, and in many instances accomplish great good, but it rarely happens that anyone in the upper stories of a high building, with a fire surging beneath, is collected enough to follow the instructions which make these fire escapes of value.

The future and most sensible fire escape will be attained when laws are enacted which will provide two or more fire proof stairways in every large building where there are many people congregated.

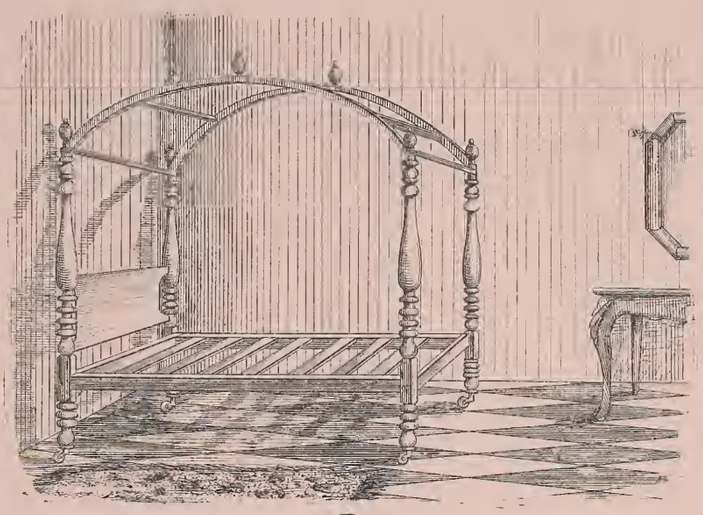
FIRE ESCAPES.

1,099 Patents Granted by the United States.

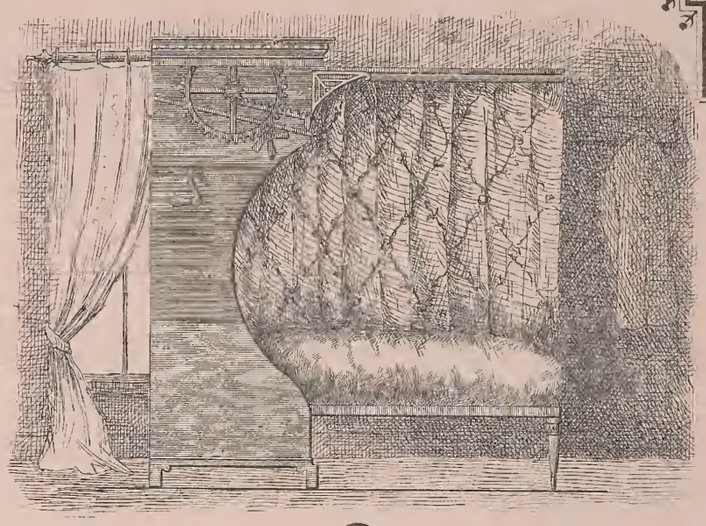
Sackett & Wilhelms Litho Co New York



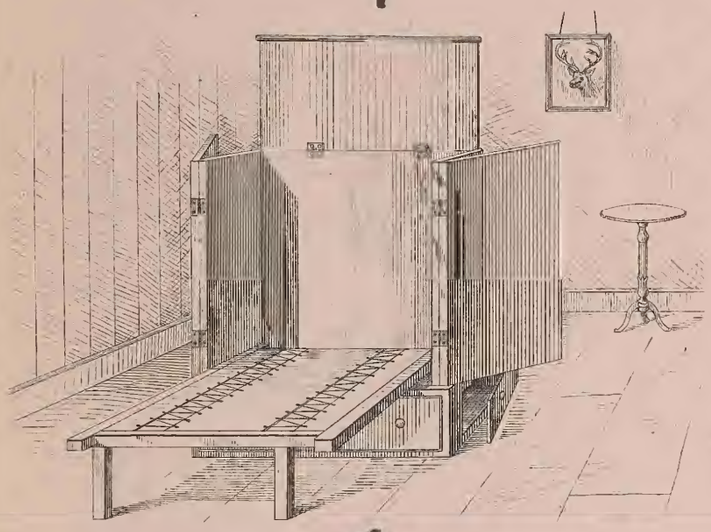
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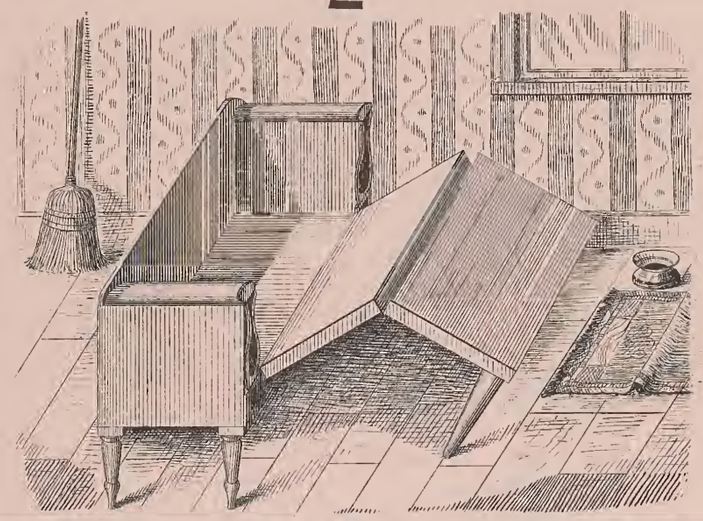
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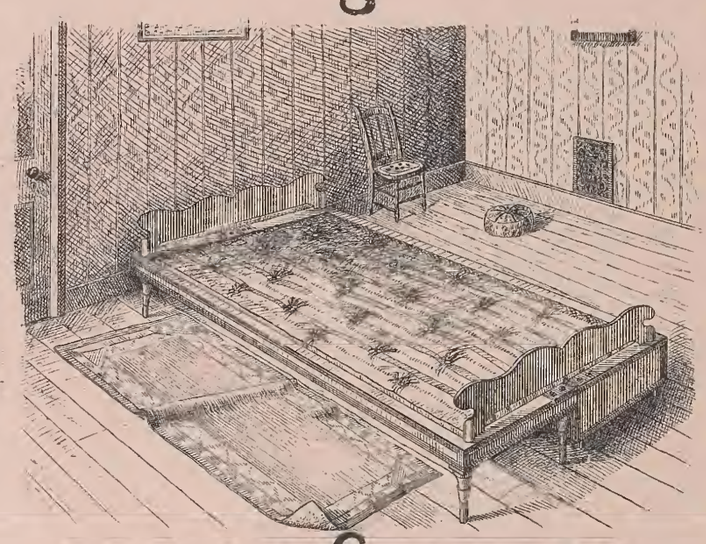
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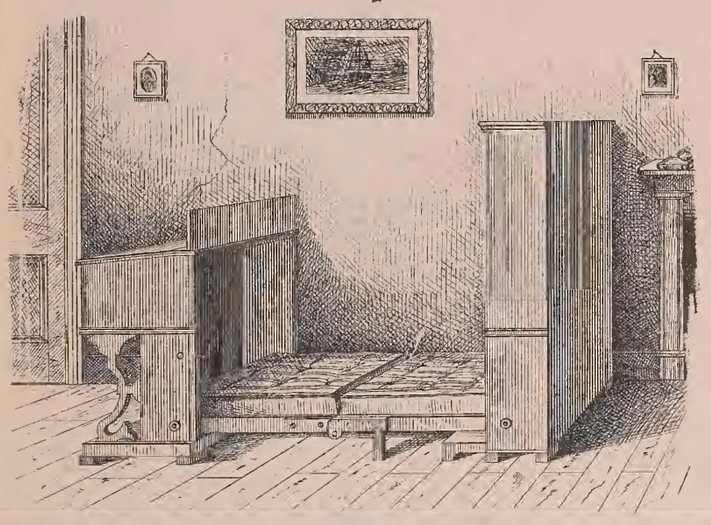
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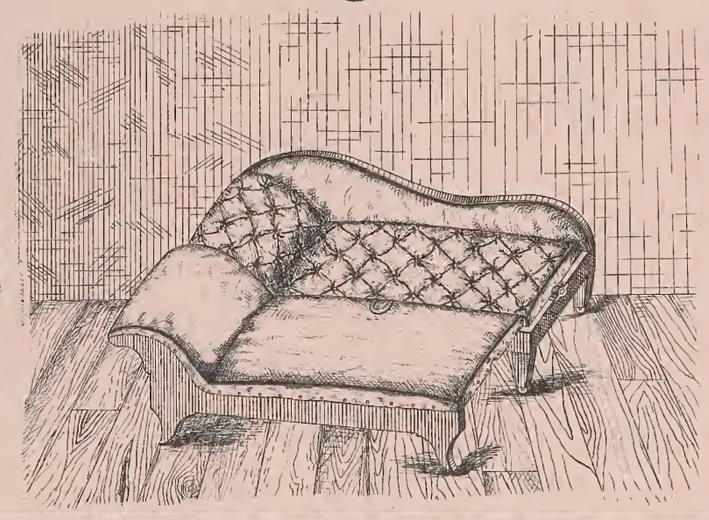
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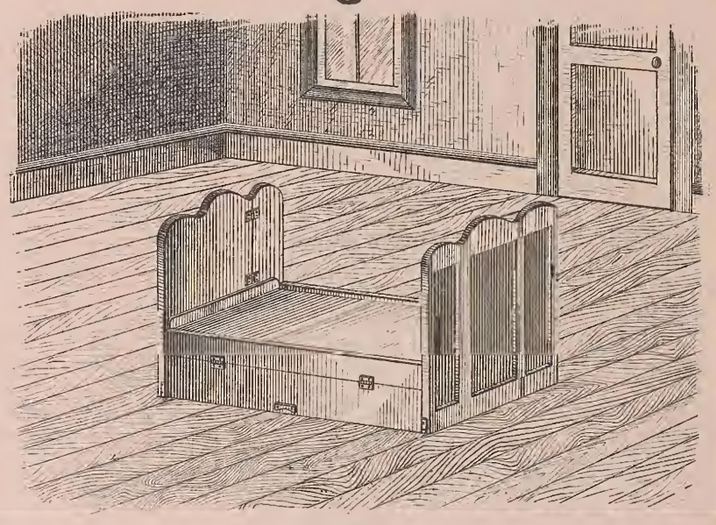
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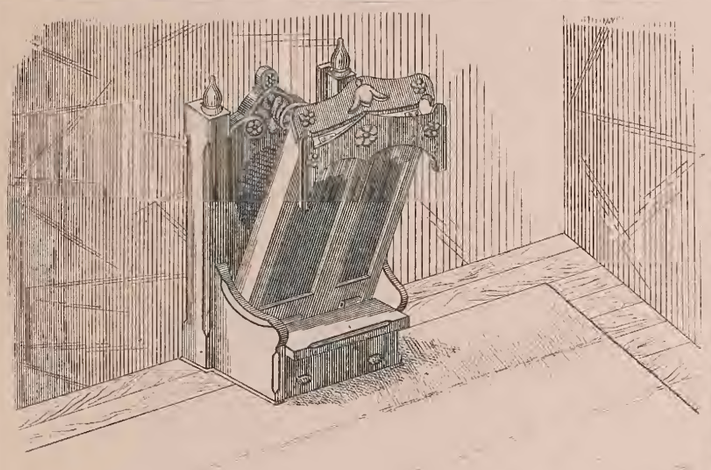
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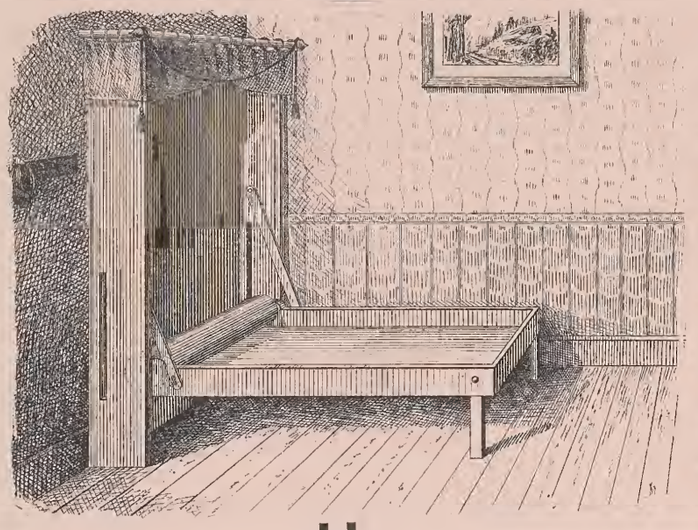
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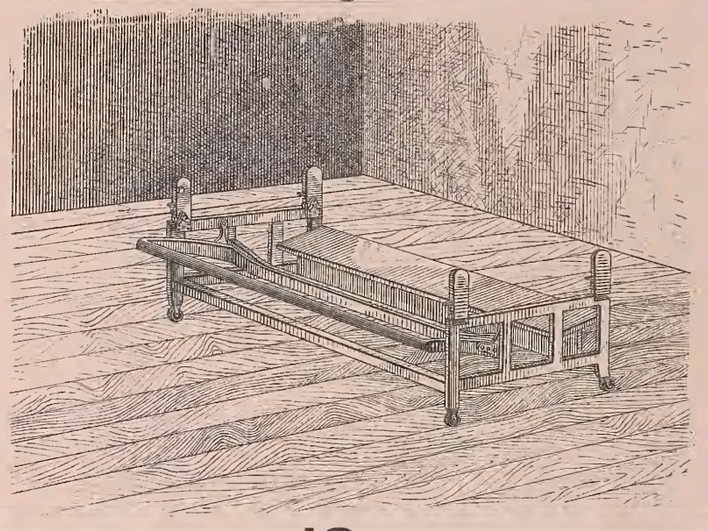
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12

BEDSTEADS.

BEDSTEADS.

No. 1. Primitive.
2. Queen Anne.
3. English—A. D. 1772.
4. Wardrobe.
5. U. S. Patent. Sofa Bedstead—A. D. 1831.
6. " " " " —A. D. 1860.
7. " " Combined Desk and Bedstead—A. D. 1871.
8. " " Bed Lounge—A. D. 1872.
9. " " Cabinet Bedstead—A. D. 1874.
10. " " Wardrobe " —A. D. 1876.
11. " " " " —A. D. 1882.
12. " " Cot Settee—A. D. 1883.

Bedsteads were common in Egypt, and among the later Greeks.

They were only used by the wealthy classes; many ornate bedsteads are represented in the tombs at various points along the Nile.

The iron bedstead of King Og, of Bashan, who is said to have lived before the flood, was nine cubits long and four bread.

The bedsteads of the Greeks had four rails, legs, straps to support the mattress, a head board, and sometimes a footboard.

They were made of solid maple or boxwood; sometimes veneered with costlier wood, tortoise-shell or ivory, and sometimes had ornamental feet of silver. The mattress was of linen, woollen cloth, or leather, stuffed with straw or wool. Round and square pillows were used, and the covering consisted of soft woollen blankets and sheets.

The sleeping arrangements of the wealthy Greeks seem to have been good, but the Asiatics said "the Greeks do not know how to make a comfortable bed."

The Roman bedsteads were costly and beautiful. The weary climbed on them by stepladders, on the open side, the other side being closed by a sideboard. The beds were stuffed with wool or feathers, and had canopies, but no mention is made of curtains or testers.

The famous ancient bedstead of Ware, alluded to by Shakespeare, is still in existence. It is twelve feet square and was probably constructed A. D. 1500.

Many innovations and improvements have been made on the old-fashioned four-post bedstead which was provided with four high posts and tester, forming, with the curtains around it, a complete canopy by which the sleeper, if so disposed, could be fully protected against fresh air. It was formerly the practice to make the bedbottom of coarse canvas having eyelet-holes along its edges, through which cord was passed, and thence over pins in the side, top and bottom rails, which supported the bed-bottom. This arrangement admitted of lacing the canvas as tightly as desired.

Various arrangements of slats and springs have superseded the old style and many improvements have been made in the manner of putting the posts together, so that the bedstead can be set up and taken down with great rapidity.

Invalid bedsteads are made with rising sections, so as to bring the body to a reclining or sitting posture.

Wardrobe, sofa, trunk, table and piano bedsteads are modes of concealing beds when not occupied, and also combine, with the bedstead, the other article of furniture which gives each its distinctive name.

Amongst the latest inventions is the hydrostatic, or water bed, used for medical purposes.

FURNITURE.

5,227 Manufactories in the United States.

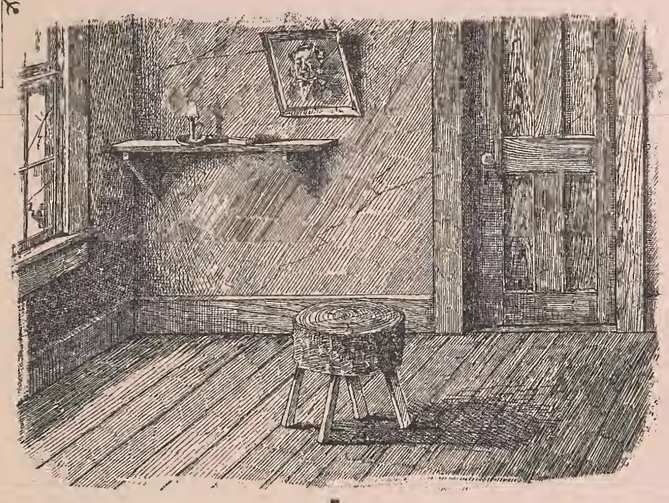
	1860	1880
Capital Invested,	$13,629,526.00	$44,946,128.00
Value of Productions,	25,632,293.00	77,845,725.00
Wages Paid,	8,909,998.00	23,695,080.00
Hands Employed,	27,106	59,304

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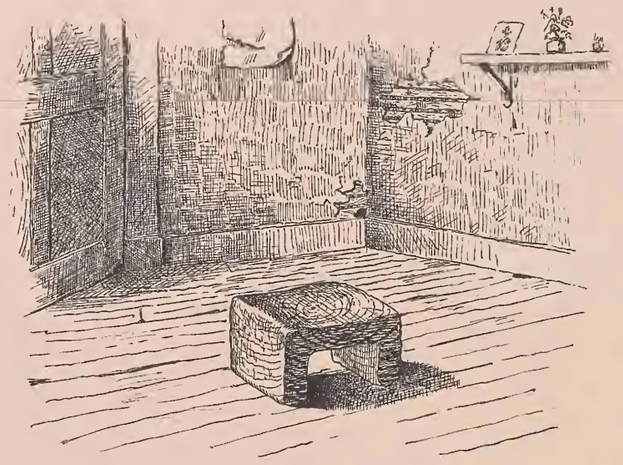
BEDSTEADS.

3,345 Patents Granted by the United States.

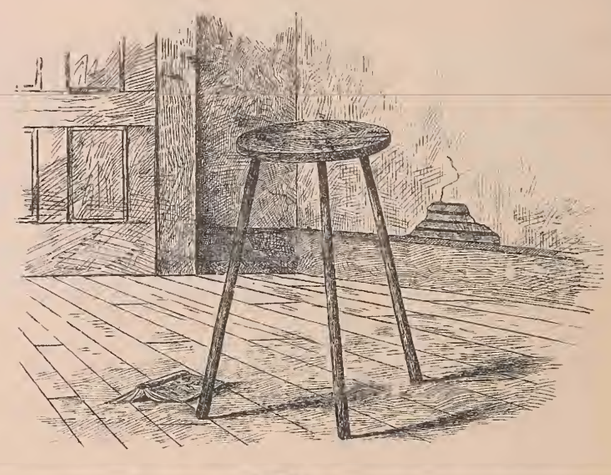
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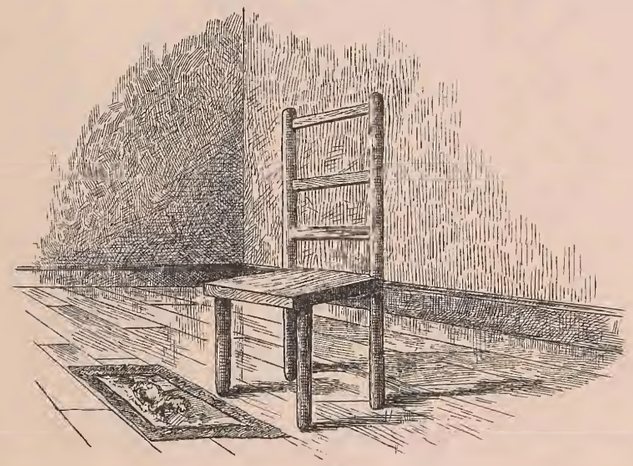
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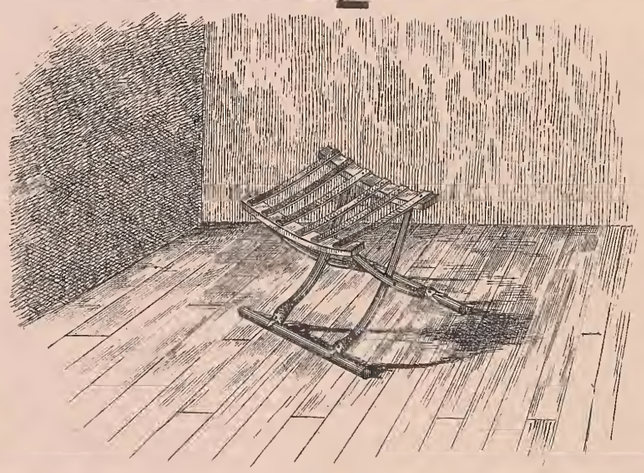
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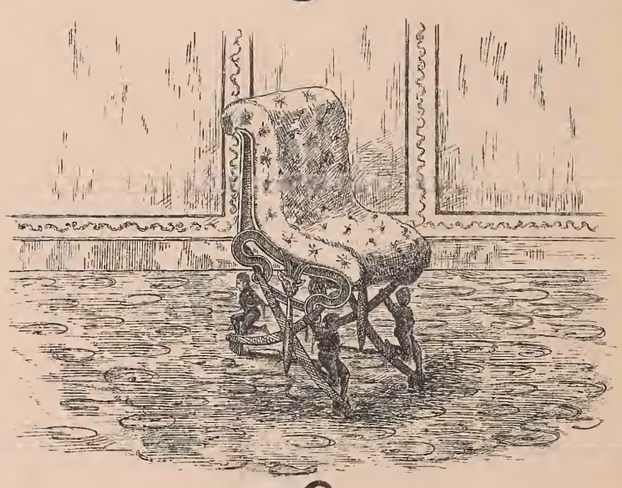
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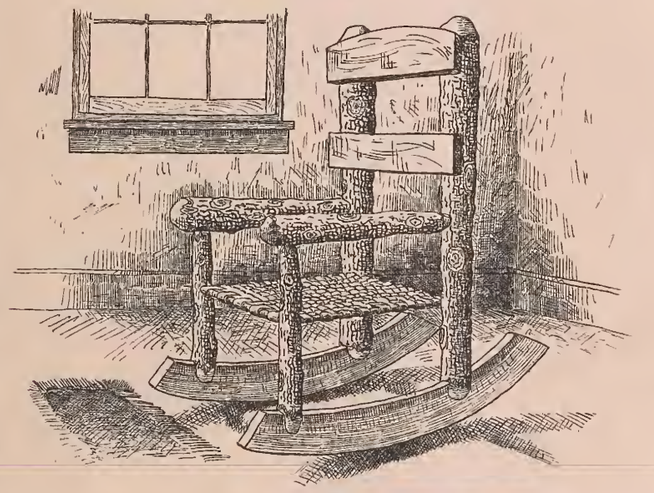
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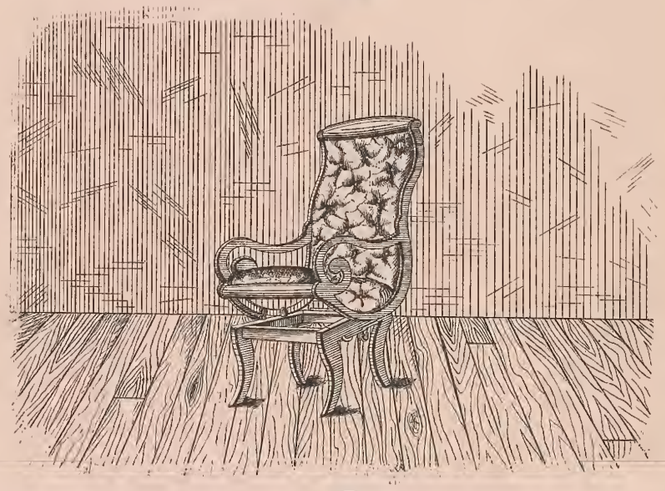
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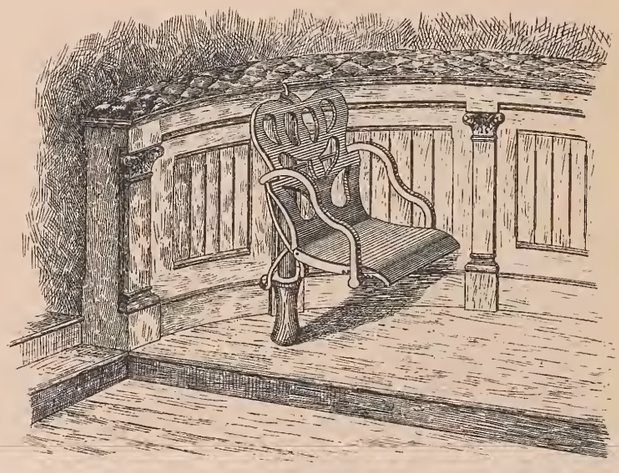
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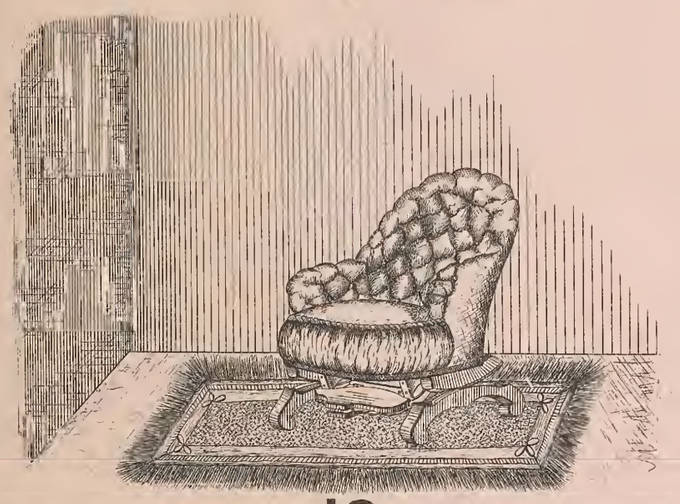
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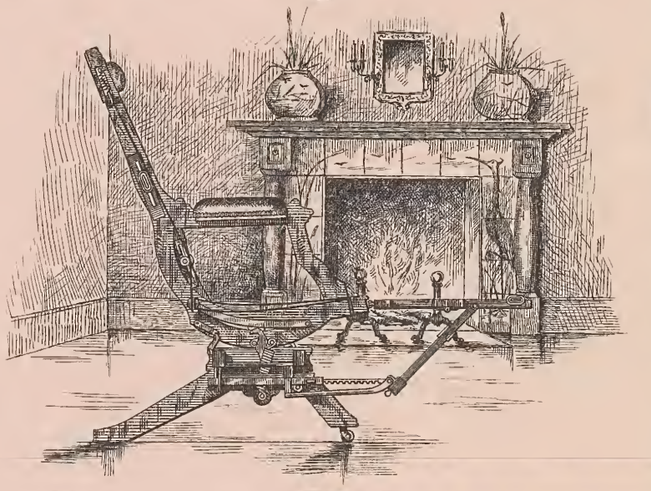
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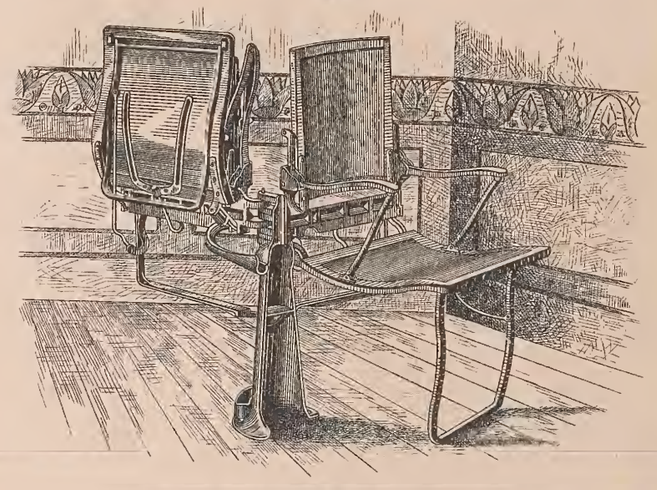
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12

CHAIRS AND STOOLS.

CHAIRS AND STOOLS.

No. 1. Primitive Seat.
2. " Stool.
3. " "
4. " Chair.
5. Egyptian Stool.
6. " Chair.
7. Crude Rocker.
8. U. S. Patent, Rocker—A. D. 1840.
9. " " Opera Chair—A. D. 1865.
10. " " Rocker—A. D. 1868.
11. " " " —A. D. 1884.
12. " " Folding Seat—A. D. 1884.

The Egyptians were among the first to make chairs. On the tombs at Thebes are found representations of almost all the kinds of chairs which modern ingenuity has devised. Thrones, couches, sociables, folding, reclining, lazy back, leather seated, cane seated, split bottomed chairs, with curved backs, sides and legs with claw feet and foot pads, and upholstered with gorgeous coverings.

The Egyptians, being an Asiatic race, it is presumable from the squatting posture in their paintings and bas reliefs, that the introduction of the chair came in the progress of refinement. The Egyptian chairs and stools were from 10½ to 28 inches high.

Alexander gave a feast to 6,000 of his captains, and made them sit in chairs and couches of silver with purple covers.

Although chairs were not unknown to the Greeks and Romans, yet they seldom used them except on state occasions.

The curule chair was made of or adorned with ivory, and was introduced into Rome by Tarquin, from Vitterbo, in Etruria. Two of them, made in the shape of our portable folding chairs, were discovered at Herculaneum.

The Anglo Saxons had rich curule chairs of state, similar to the Romans, and wooden and rush bottom chairs were common with them.

The sedan chair was first made use of by the Duke of Buckingham, in the reign of James I, to the great indignation of the people, who exclaimed that "he was employing his fellow creatures to do the work of beasts." A license for letting them out was granted Sir Saunders Duncomb, in 1634.

Modern chairs are classified under the following heads: Barber's, convertible, dentist's, folding, invalid, nursery, opera, oscillating, reclining, revolving, rocking, step ladder, surgical, and tilting.

CHAIRS AND STOOLS.

384 Chair Manufactories in the United States.

	1880
Capital Invested,	$6,276,364.00
Value of Productions,	9,807,823.00
Wages Paid,	3,311,286.00
Hands Employed,	10,575

2,596 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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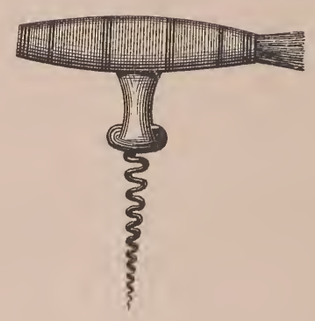
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CORK EXTRACTORS.

CORK EXTRACTORS.

No. 1. Primitive Hand.
2. " Teeth.
3. " Nail.
4. " Double Fork.
5. Cork Screw.
6. " " Brush Attachment.
7. U. S. Patent, Cork Screw—A. D. 1867.
8. " " Cork Extractor and Cutter—A. D. 1867.
9. " " Cork Extractor—A. D. 1882.

The corkscrew was unknown to our forefathers two hundred years ago.

Various methods of extracting corks were resorted to in olden times, such as winding a cloth or handkerchief tightly around the cork, and with a peculiar jerk pulling the stopper out of the bottle; breaking the neck of the bottle was a common practice, and many persons became very expert in removing corks with the teeth.

The earliest mention of the corkscrew is in an amusing poem entitled "The Tale of the Bottle Screw," in a collection of poems by Nicholas Amhurst, published in 1723. Bacchus is described in the poem, and among other things, it is said of him:

"This hand a corkscrew did contain,
And that a bottle of champagne."

Yet at that time "bottle screw" appears to have been the common name of this useful article, for the poet concludes his tale with the following lines:

"By me shall Birmingham become
In future days more famed than Rome;
Shall owe to me her reputation,
And serve with bottle screws the nation."

The modern corkscrew came into use about the beginning of the last century, and was for many years called a "bottle screw."

Corkscrews, like corks, are to be found, in some shape or other, in all parts of the civilized world.

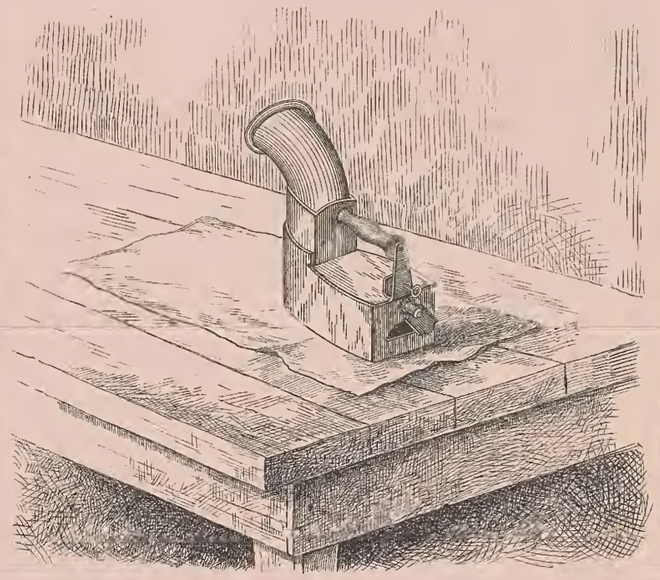
CORK EXTRACTORS.

116 Patents Granted by the United States.

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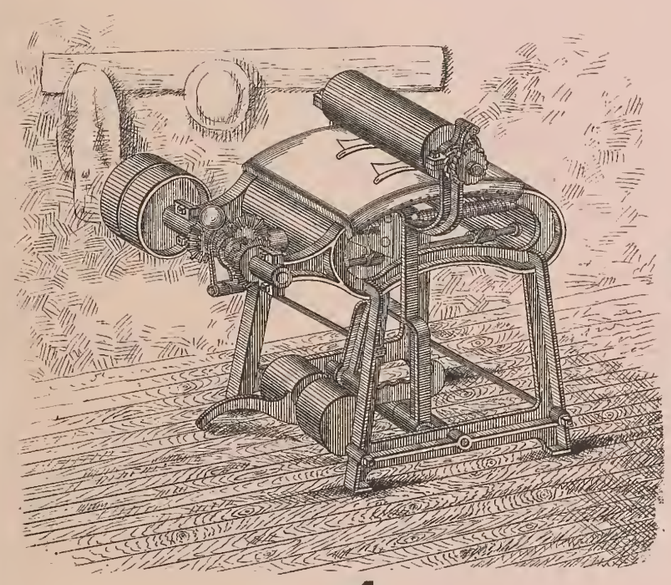
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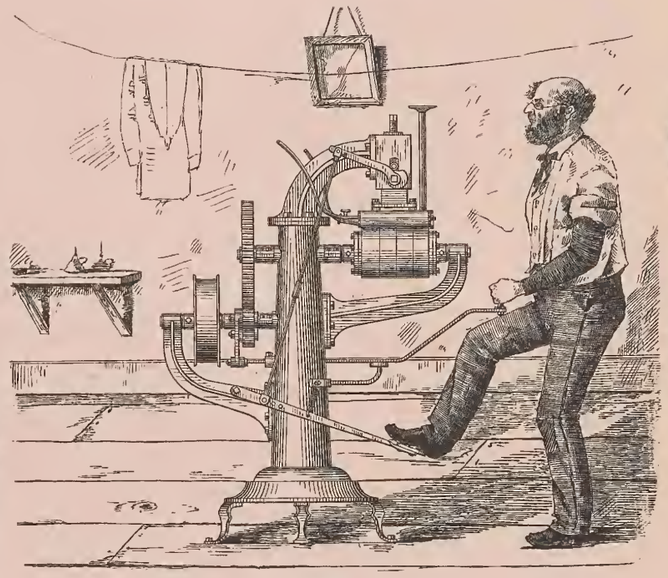
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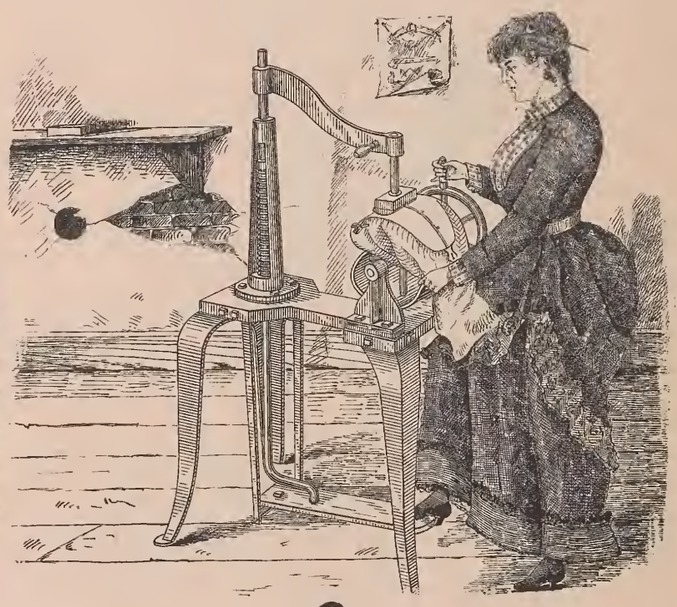
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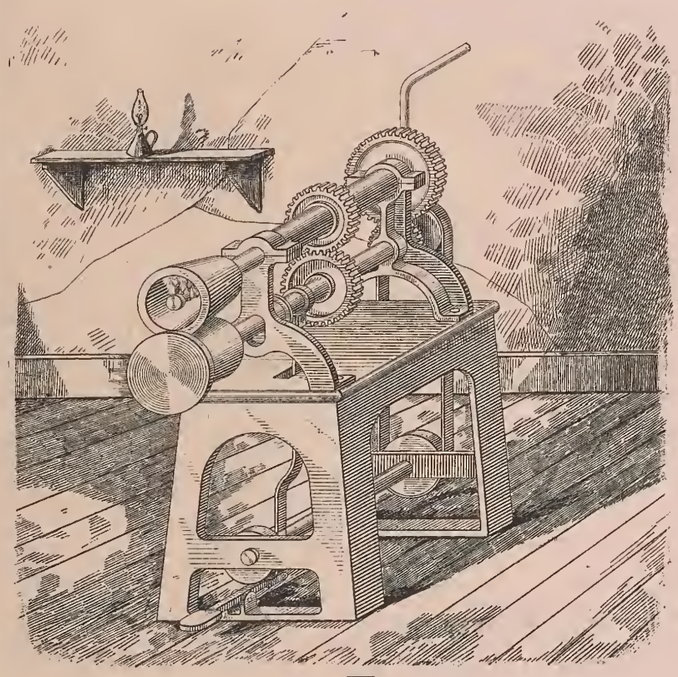
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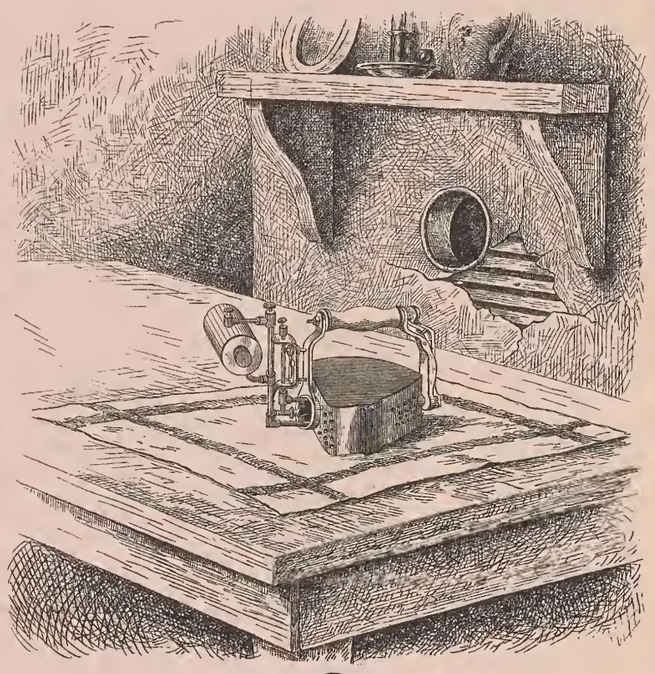
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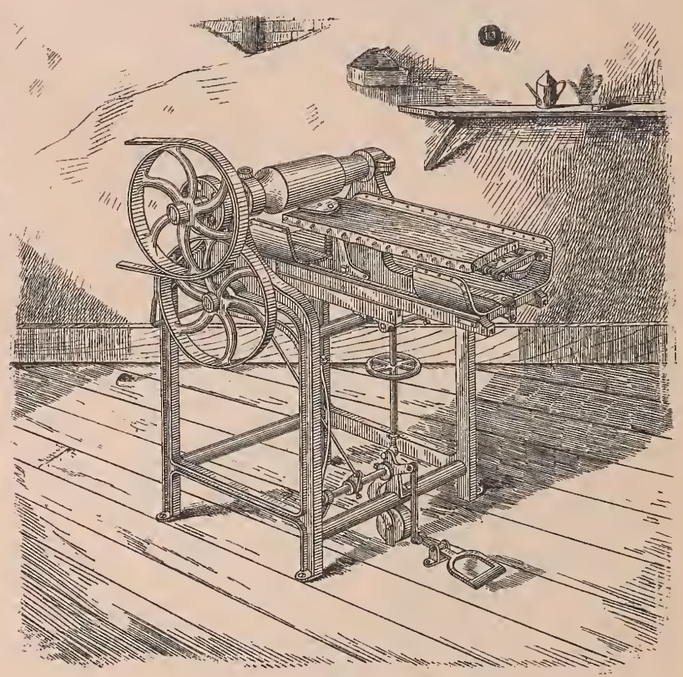
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IRONING.

IRONING.

No. 1. Flat Iron.
2. U. S. Patent, Sad Iron—A. D. 1852.
3. " " Smoothing Iron—A. D. 1873.
4. " " Ironing Machine—A. D. 1878.
5. " " " " —A. D. 1879.
6. " " " " —A. D. 1882.
7. " " Cuff and Collar Ironer—A. D. 1882.
8. " " Smoothing and Fluting Iron—A. D. 1882.
9. " " Ironing Machine—A. D. 1884.

A wooden tool of the same shape as the common flat iron has been discovered in Thebes. It was used for smoothing and pressing cloth, and is about six inches in length, and made of very hard wood.

The ordinary flat iron, heated before a fire, or on a stove, with which the laundry maid, by muscular force, ironed out clothing, has become almost a thing of the past. Even where the iron is now used, it is generally heated either by a flexible tube from the gas jet, or by a fire inside of the iron itself. Even the mangle has given place to improved ironing machines, some heated by steam, which iron with equal facility the most delicate piece of lace or the coarsest fabric worn, whilst the fluting attachment does away with the fluting scissors and the deft fingers which used them.

In the latest improved devices, the article which requires washing, no matter how elaborate its make-up, is simply passed through a series of machines and comes out washed, starched, fluted, ironed and polished.

The first steam laundry in the United States was started in Boston, Massachusetts, in 1853. Several, located in New York city, employ from 100 to 150 hands each.

The Empire laundry turns out more than 100,000 pieces per month. It is said that from ten to twenty thousand persons are employed in New York city alone in laundry work.

IRONING.

Capacity—	Primitive Mode.	Present Machine.
Doz. Cuffs or Collars per day,	50	600
Hands employed per day,	2	2

551 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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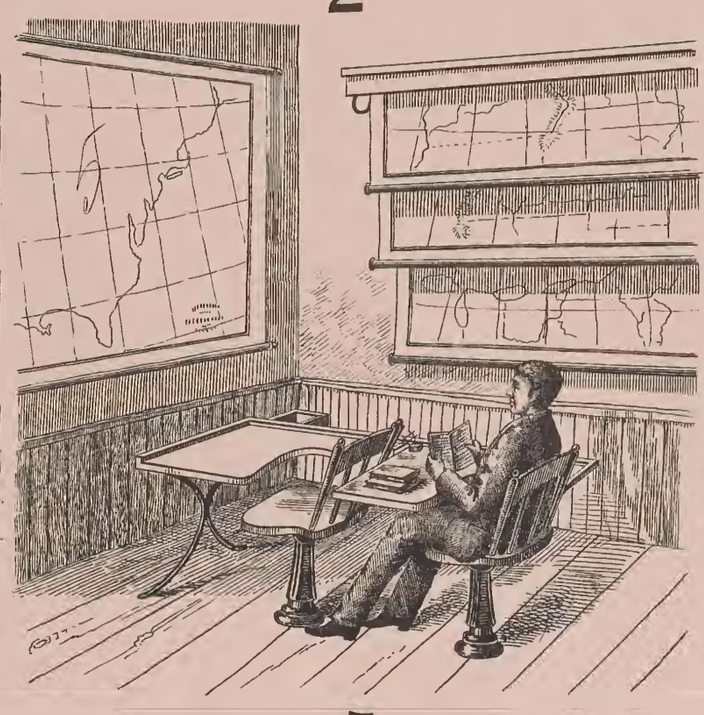


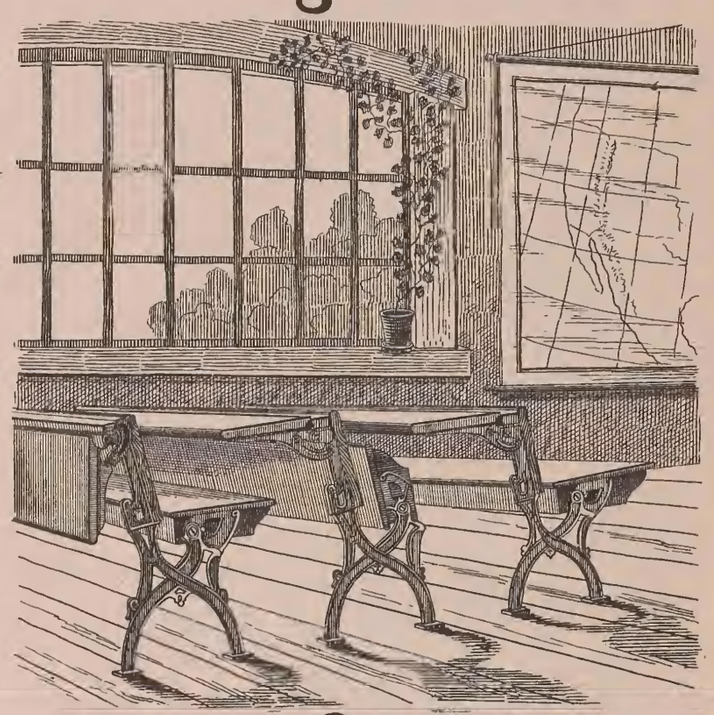
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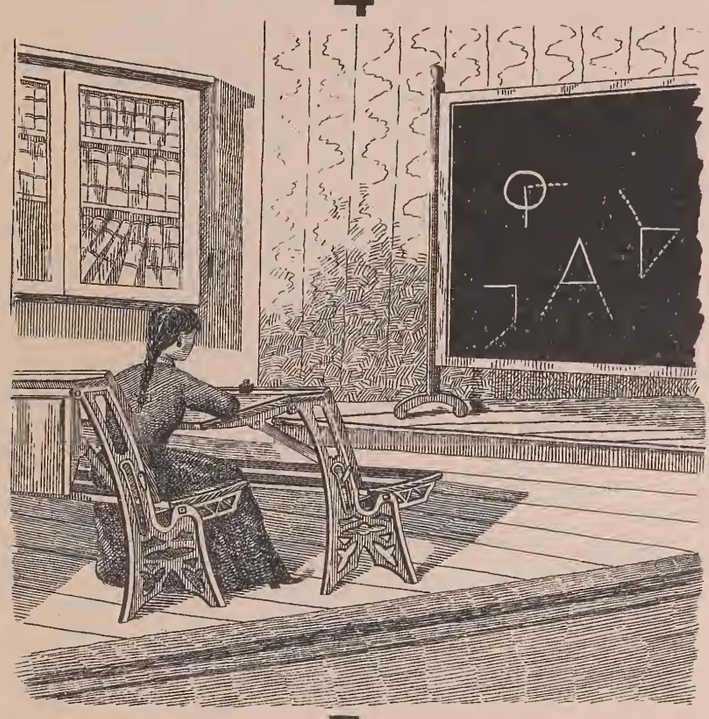
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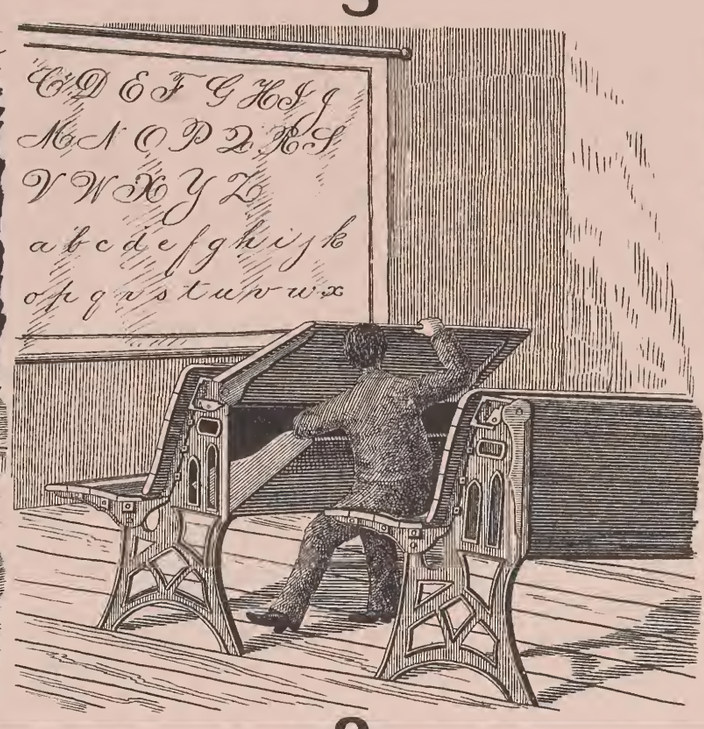




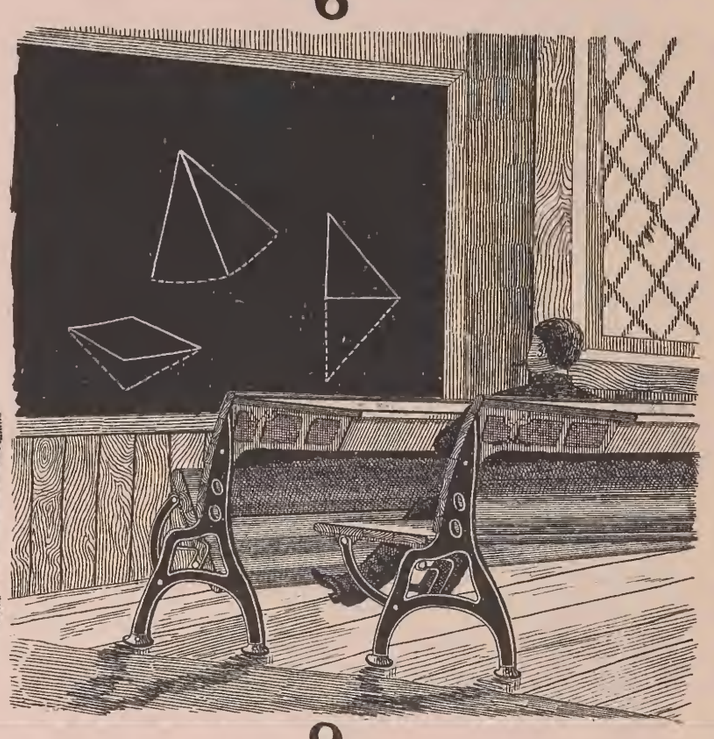
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SCHOOL FURNITURE.

SCHOOL FURNITURE.

No. 1. Primitive Bench.
2. " Desk and Bench.
3. " Seat and Desk.
4. U. S. Patent, Adjustable Seat—A. D. 1859.
5. " " Combined Seat and Desk—A. D. 1868.
6. " " Folding Desk and Seat—A. D. 1869.
7. " " " " —A. D. 1869.
8. " " Combined Desk and Seat—A. D. 1883.
9. " " Folding Desk and Seat—A. D. 1884.

Desks, resembling those now in common use, have been discovered at Herculaneum, though the ancients usually wrote upon the knee, as is still customary in Asia and Africa.

Plato taught his scholars upon the Acropolis, in a grove of palm trees, standing himself, whilst the pupils stood, reclined upon the earth, or leaned against the numerous statues which adorned the grove and were the only "furniture" of this, the most magnificent school house either of ancient or modern times.

Fixed stone seats were provided in some of the ancient school houses. Then came movable wooden benches.

The Egyptian, who was taught to write on papyrus, was stretched prone upon the earthen or stone floor, resting upon his left arm or elbow, with the roll of papyrus also upon the floor within reach of his hand.

The Roman scholar, who learned to write upon parchment, reclined upon a bench, whilst the Hebrew sat up, with a table before him.

At the revival of literature, as light began to dawn from the night of the dark ages, schools were established where seats and tables were given to the pupils.

Seats and tables, or more latterly desks, are still the only form of school furniture. Modern times have required that these seats and desks should combine, as far as practicable, an easy and comfortable seat for the scholar, as great economy of space as is practicable, and durability.

The most common form is the seat composed of an iron frame and wooden seat, with a desk attached to the back, for the use of the scholars in the next rear row, with desk and seat both arranged to fold.

SCHOOL FURNITURE.

2,257 Manufactories in the United States.

	1860	1880
Capital Invested, -	$13,629,526.00	$44,946,128.00
Value of Productions, -	25,632,293.00	77,845,725.00
Wages Paid, - -	8,909,998.00	23,695,080.00
Hands Employed. - - -	27,106	59,304

271 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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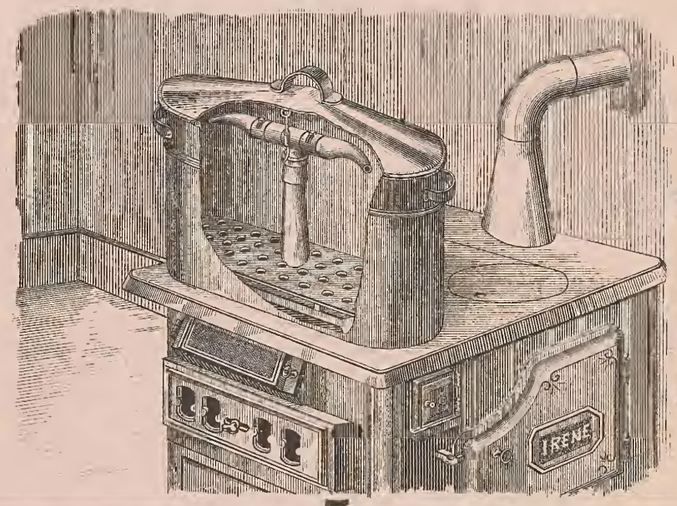
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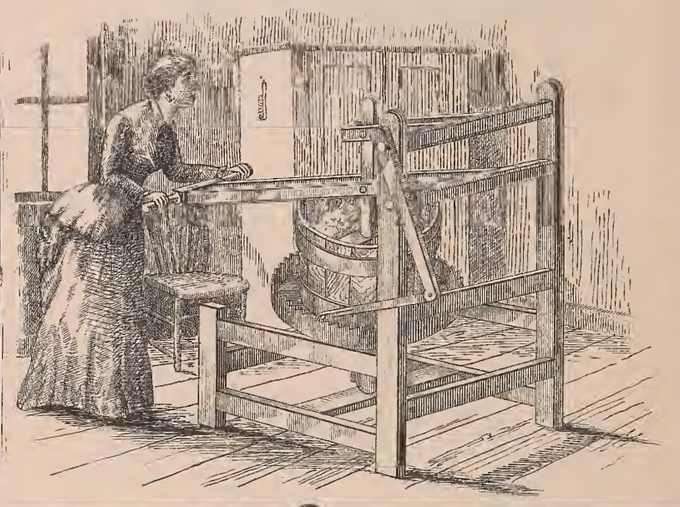
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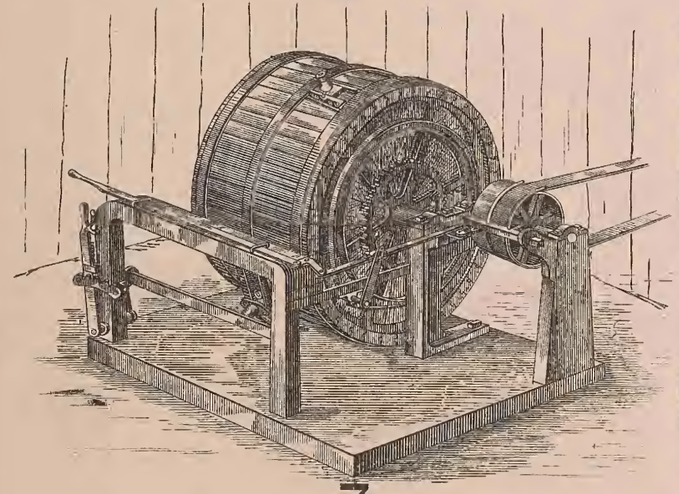
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12

WASHING MACHINES.

WASHING MACHINES.

No. 1. Primitive Indian Dhobees.
2. Colonial.
3. Hand.
4. U. S. Patent, Vertical Rubber—A. D. 1869.
5. " " Boiler—A. D. 1874.
6. " " Vertical Pounder—A. D. 1878.
7. " " Rotary Steam—A. D. 1880.
8. " " Oscillating Rubber—A. D. 1882.
9. " " Rotary " —A. D. 1883.
10. " " Vertical " —A. D. 1883.
11. " " Inclined " —A. D. 1883.
12. " " Vertical Pounder—A. D. 1884.

Clothes were formerly washed by rubbing or stamping upon them in water, or beating them against rough bodies.

The following modes of washing by machinery are embraced in the modern machine:

1st, Churning: the clothes are beaten by a pounder in a tub. 2d, the Dash Wheel. 3d, Sluicing, the hot water being driven through the clothes. 4th, Centrifugal. 5th, Twisting. 6th, Squeezing. 7th, Rolling. 8th, Rubbing. 9th, Rocking.

Millions of washboards are made and sold in the United States every year, and at least 7,200,000 are sold yearly.

There are two factories in Cleveland which turn out 200 dozen washboards a day, and one in Toledo which turns out over a million a year.

There are at least twenty different varieties of washboards, and the best are made in the West.

The Eastern factories make their washboards of pine.

The best wood for washboards is cotton wood or sycamore; pine is too soft, and white pine is too expensive. The best are made with dovetailed heads, with wire nails driven across the grain of the wood.

WASHING MACHINES.

61 Manufactories in the United States.

	1860	1880
Capital Invested,	$34,700.00	$652,549.00
Value of Productions,	87,565.00	1,182,714.00
Wages Paid,	20,124.00	176,287.00
Hands Employed,	85	478

Capacity—	Primitive Mode.	Present Machine.
Shirts per day,	50	600
Hands employed per day,	1	1

2,458 Patents Granted by the United States.

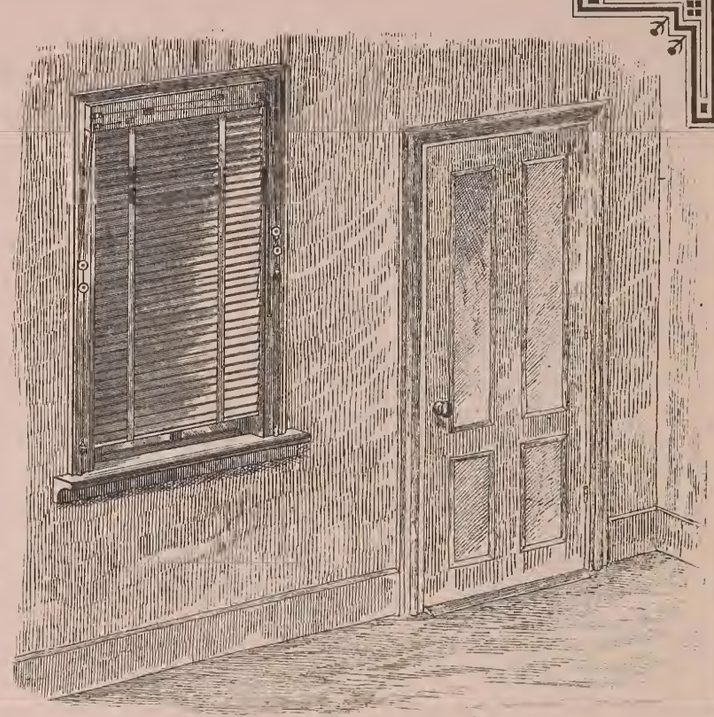
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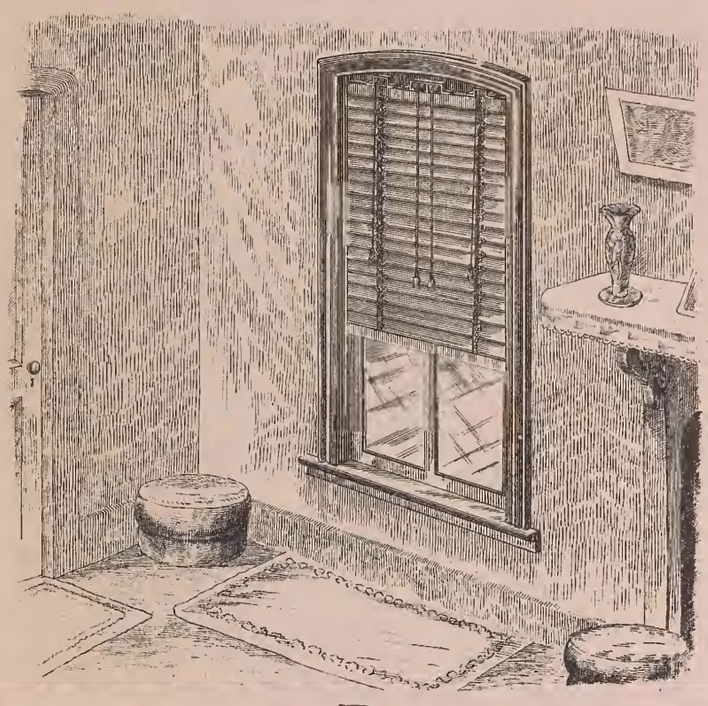
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WINDOW BLINDS.

WINDOW BLINDS.

1 U. S. Patent, Window Blind—A. D. 1825.
2. " " Inside Blind—A. D. 1847.
3. " " Window Shade—A. D. 1850.
4. " " Inside Blind—A. D. 1858.
5. " " Window Blind—A. D. 1864.
6. " " Window Blind—A. D. 1875.
7. " " Slat Curtain Blind—A. D. 1878.
8. " " Window Curtain—A. D. 1880.
9. " " Window Shades—A. D. 1884.

The first window of which we have any mention is "A window in the ark."

Primitive windows were mainly for ventilation, and the word means "wind-door," and no blinds were used.

Pliny and Tertullian mention horn windows.

Among the Romans windows were originally closed with shutters.

According to some authorities there are traces of glass windows with protecting blinds having been used in Pompeii. but this is a matter of grave doubt.

In the East, from time immemorial, the windows, which always opened upon a court and not upon the street, were protected by the most primitive window blind, called "lattices" or "jalousies." The lattice answered in ancient times the purpose both of window and blind, and consisted of a framework of horizontal and perpendicular bars interlaced.

The Venetians led the way among European nations during the 16th and 17th centuries, and the graceful Venetian blind, which consists of movable slats fastened and worked by cords, was invented by them. These have not yet fallen into desuetude.

The cheapest and most graceful blind is a horizontal assortment of wooden slats held in a wooden frame and suspended either inside or outside the window. The use of these is almost universal.

There is a metallic blind which is hinged at the top and drawn upwards by cords to form an awning. Rods hinged to its outer edge are let down to form supports.

Another invention is known as the roller blind. It is made of slats and adapted to close any portion of the window, either above or below the meeting rails of the sashes.

Another is known as the flexible blind. This is wound on a roller, upon whose journals are wound the side tapes which are connected to the window frame above. One cord supports in its loop and adjusts the height of the lower roll of the blind; the other cord winds with the upper roll and adjusts its height by winding it or allowing it to unwind its contents.

Modern invention offers every variety of blind, window shade or curtain, from the paper curtain which is within the reach of the poorest, to the lace and tapestry of the rich.

A most useful one is of linen, which is worked on a roller with the aid of a spring. These are of very general use, and many different patents have been issued therefor.

WINDOW BLINDS.

131 Manufactories of Window Blinds and Shades in the United States.

	1860	1886
Capital Invested, -	$23,950.00	$1,385,515.00
Value of Productions, -	134,620.00	2,826,518.00
Wages Paid, - -	34,924.00	479,133.00
Hands Employed, - -	83	1,279

129 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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WRINGERS.

WRINGERS.

No. 1. Hand.
2. U. S. Patent, Machine—A. D. 1847.
3. " " Adjustable Roll—A. D. 1855.
4. " " " " —A. D. 1861.
5. " " Roller—A. D. 1862.
6. " " " —A. D. 1872.
7. " " " —A. D. 1872.
8. " " " —A. D. 1875.
9. " " " —A. D. 1878.

The ordinary clothes wringer used by the washerwoman is a wooden frame with rollers, through which the wet articles are passed to squeeze out the water. These rollers are governed by a common wooden screw, which forces them closer together or allows them to separate as heavier or lighter fabrics are to be passed through them.

But the laundry requires a better machine, and those most in use are the "Tolhurst Extractor," the "Universal," and the "Novelty" wringers.

The first of these consists of a perforated copper basket, enclosed in a cylindrical case. This basket is made to revolve at the rate of a thousand revolutions to the minute, which drives out all the water.

The "Universal" and "Novelty" wringers consist of two parallel rolls of vulcanized rubber, fitted to double-geared shafts. The uppermost roll is set in loose boxes, and pressure is applied by means of a wooden spring. To prevent the rolls from softening by use, they are treated to several coats of varnish, then wound with linen thread, and varnish applied to this, after which they are covered with rubber cement.

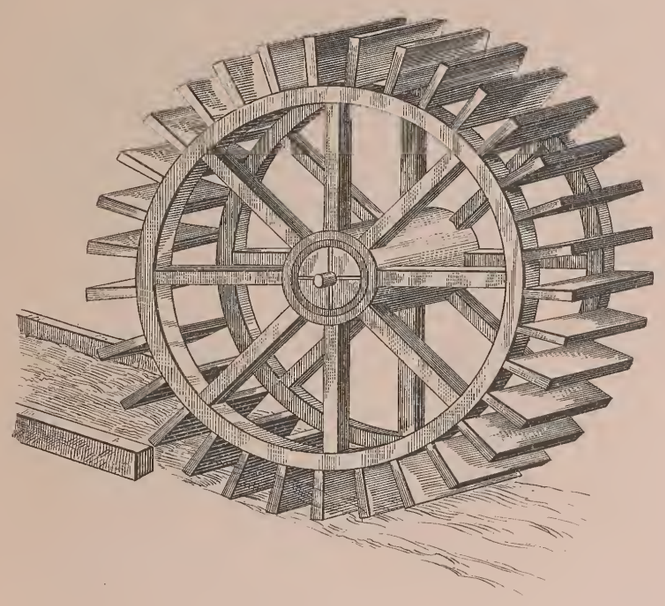
WRINGERS.

61 Manufactories of Washing Machines and Wringers in the United States.

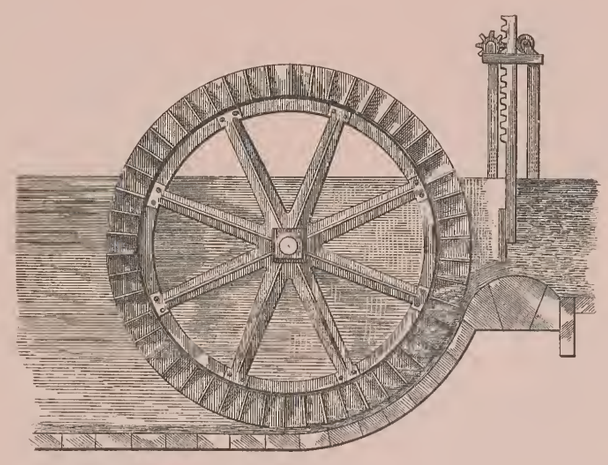
	1860	1880
Capital Invested,	$34,700.00	$652,549.00
Value of Productions,	87,565.00	1,182,714.00
Wages Paid,	29,124.00	176,287.00
Hands Employed,	85	476
CAPACITY—	Primitive Mode.	Present Machine.
Shirts per day,	50	600
Hands employed per day,	1	1

510 Patents Granted by the United States.

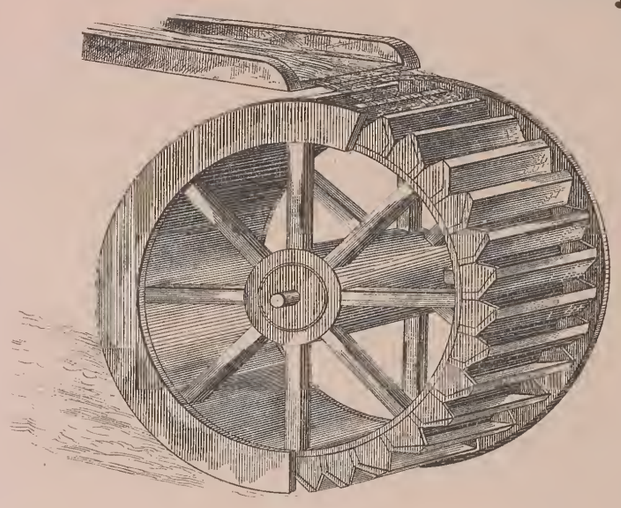
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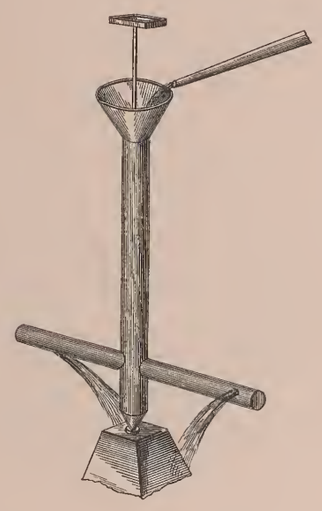
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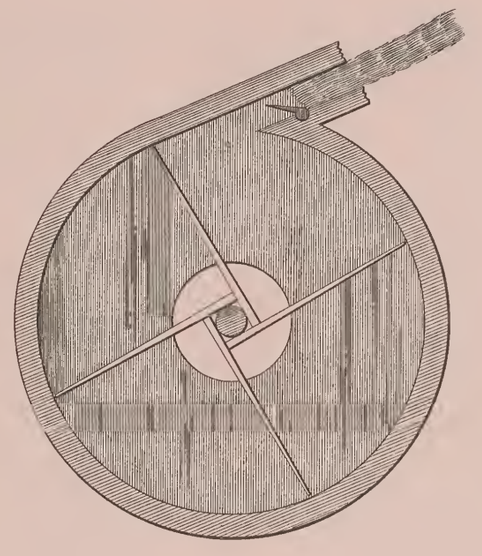
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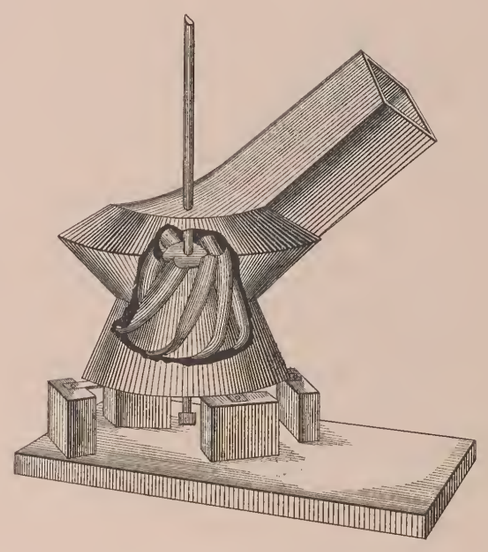
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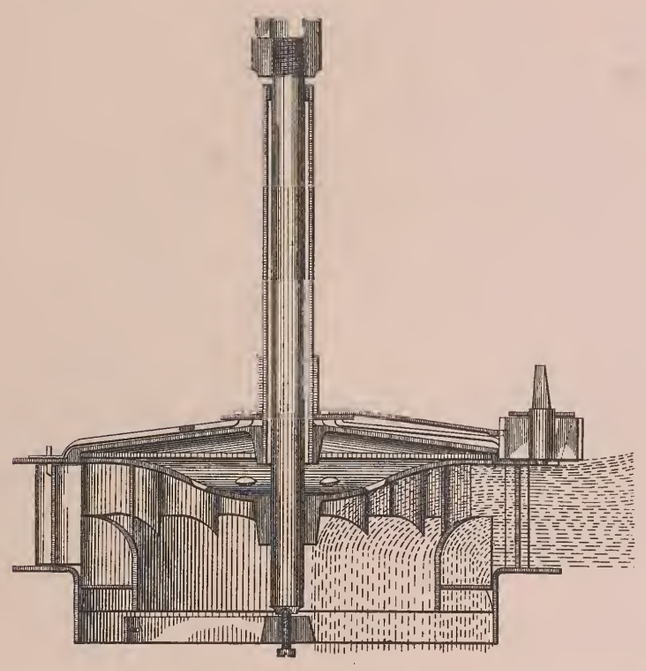
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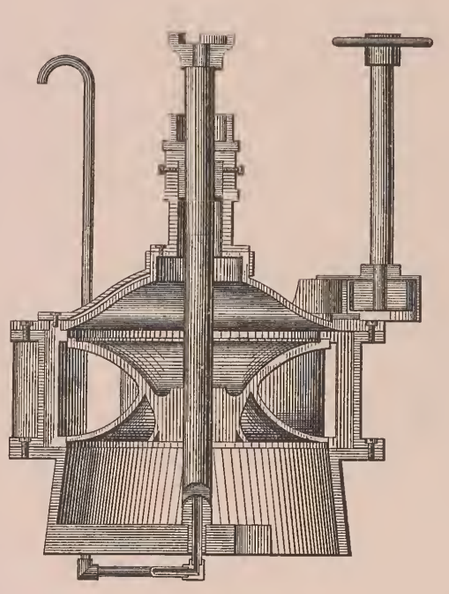
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HYDRAULIC MOTORS.

HYDRAULIC MOTORS.

No. 1. Undershot Water Wheel.
2. Breast Water Wheel.
3. Overshot Water Wheel.
4. Barker's Mill.
5. U. S. Patent, Overshot Water Wheel—A. D. 1831.
6. " " Turbine " " —A. D. 1856.
7. " " " " " —A. D. 1864.
8. " " " " " —A. D. 1884.

The current wheel is perhaps the first application of the force of water in motion in driving machinery.

The Horia or water wheel has been in use for thousands of years in Egypt, Persia, Arabia and Syria, and was introduced by the Romans or Saracens into Spain. Hundreds of these wheels are working day and night the year round in the rivers and streams of Syria and Palestine.

In the first century B. C. water wheels for driving mills were used in Asia Minor. They were used on the Tiber on a large scale by Belisarius during the siege of Rome, when the supply by the aqueduct was cut off by the Goth Vitiger, in the reign of Justinian. A. D. 536.

The tide and current wheels erected first in the vicinity of the north end of London Bridge, and subsequently under its northern arch, were erected by Peter Morice, a Dutchman, in 1582, and operated force pumps, which supplied a part of London with water.

During the seventeenth and eighteenth centuries the works were extended from time to time and occupied one after another of the arches.

The first practical turbine water wheel was invented by Fourneyron, of France, in 1834. The turbine was introduced into general use in France in 1827, and soon after by Fairbairn in England, and by Boyden in the United States.

At the Boyden nail works, Troy, N. Y., the undershot wheel furnishing the power required is sixty feet in diameter and twenty-two feet in breadth.

The largest water wheel in the world is probably one employed in the working of a lead and silver mine in the Isle of Man. This is an overshot wheel seventy-two feet six inches in diameter, six feet in breadth, with a crank stroke of ten feet. It is estimated to give two hundred horsepower, and pumps two hundred gallons of water a minute, four hundred yards high.

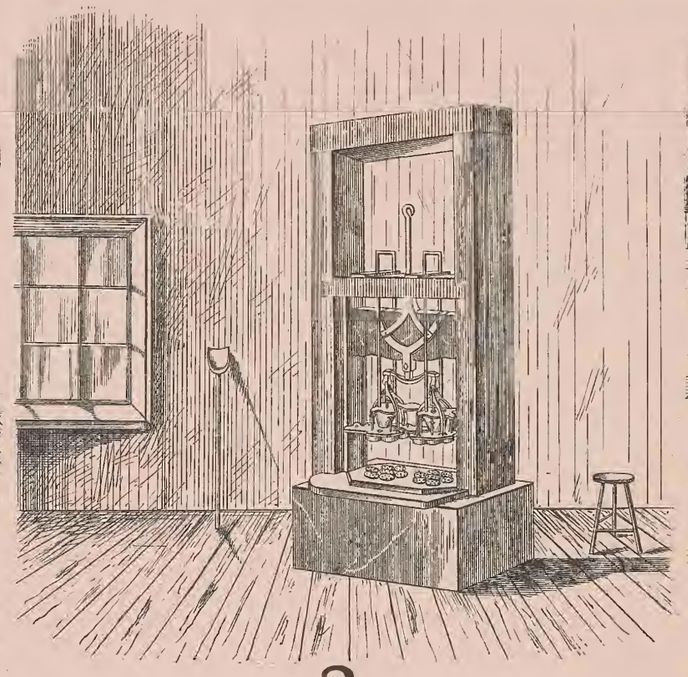
HYDRAULIC MOTORS.

1,346 Patents Granted by the United States.

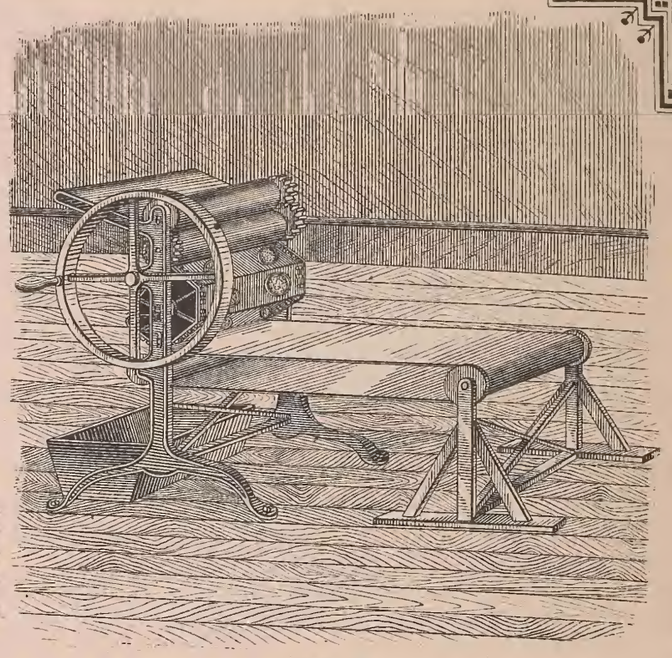
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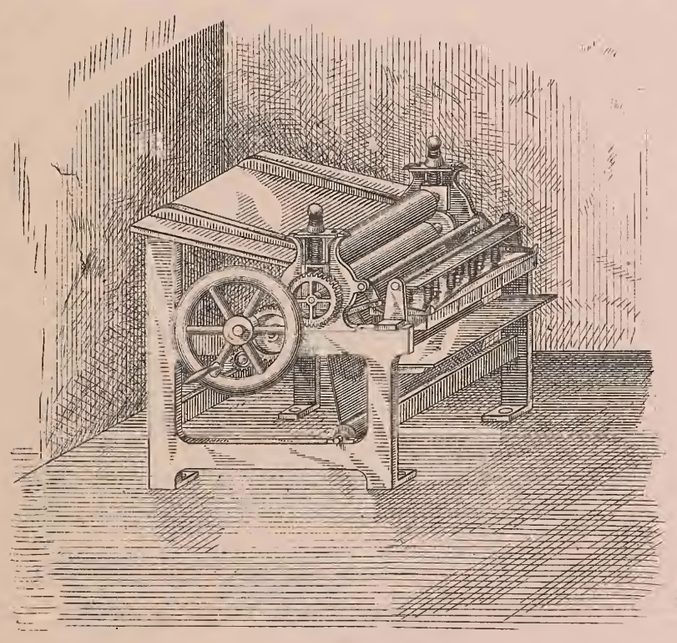
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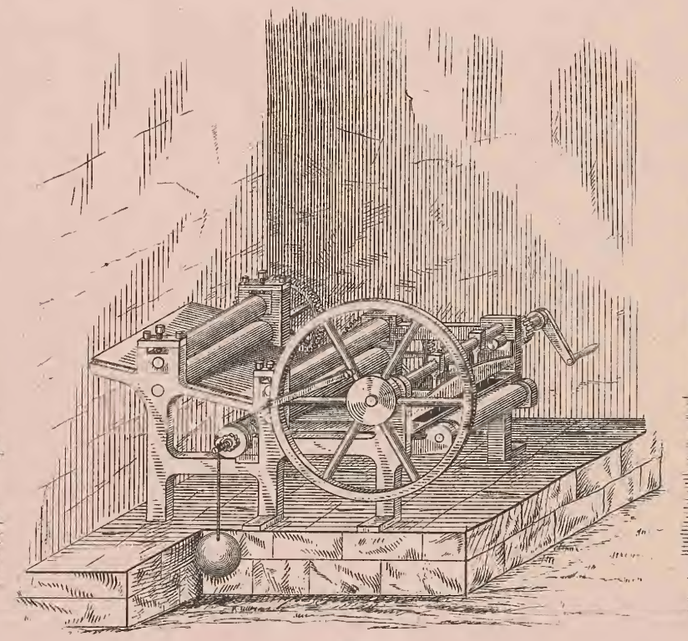
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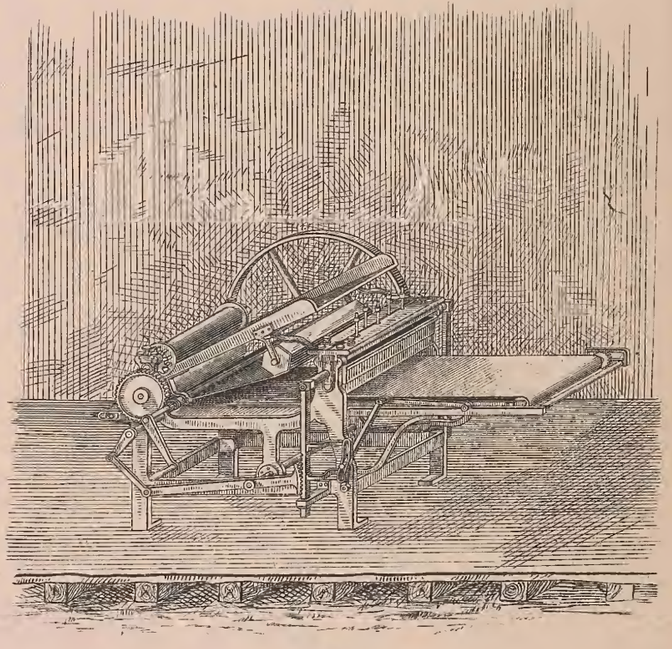
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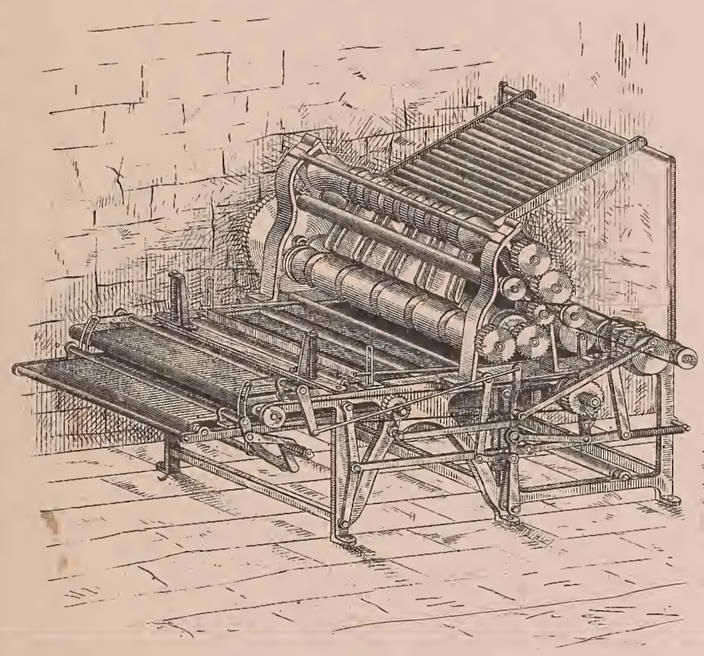
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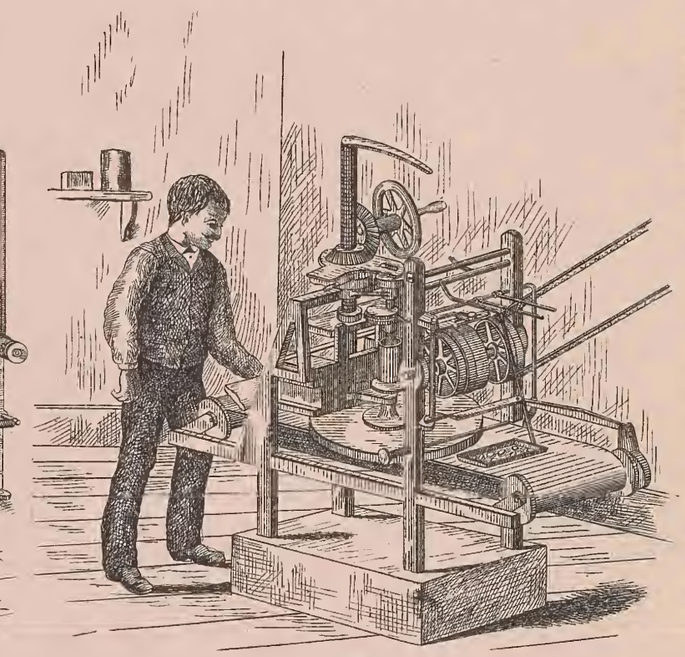
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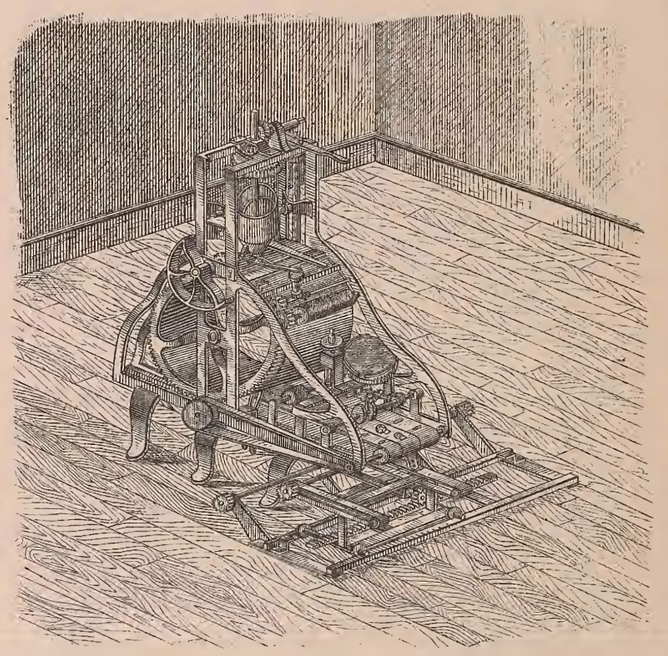
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BREAD AND CRACKER MACHINES.

BREAD AND CRACKER MACHINES.

No. 1. Primitive Bread Making, Hand.
2. U. S. Patent, Cracker—A. D. 1826.
3. " " " —A. D. 1841.
4. " " " —A. D. 1844.
5. " " " —A. D. 1848.
6. " " Bread Machine—A D. 1848.
7. " " Cracker Machine—A. D. 1859.
8. " " Cake Machine—A. D. 1869.
9. " " Bretzel Machine—A. D. 1883.

Bread making is mentioned both in the Old and New Testaments; this duty was performed by the mistress of the house.

The Israelites ate leavened bread, except on special occasions.

The Arabs baked pastry bread on pans or griddles, and called it fritters, as at the present time.

The Egyptians, like English bakers, kneaded bread with their feet; this practice is probably more general among the bakers of this country than we would like to know.

Ching-Noung first taught the art of making bread from wheat, and wine from rice, 1998 B. C. A few years subsequently, 1913 B. C., Melchisedeck brought out wine and bread to Abraham, and blessed him.

A few years later Abraham gave strangers bread to stay their hunger, while his wife prepared hot cakes made of fine meal, which were served with butter.

The Hebrews baked bread on the hearth; the cakes were flat.

In the time of Pliny bread was made from a variety of grains, wheat being held in the highest estimation. The wheat of Italy ranked first in whiteness and weight; that of Sicily stood third.

The Romans leavened their bread with a preparation known as salt rising, instead of yeast. The Roman leaven is described as "being made from millet mixed with grape juice, which will keep a year."

Wheat bran was also used. This kind of leaven could only be made during the vintage; they made another kind of barley and water which could be prepared at any time. This was made into cakes of two pounds, which were baked until they became of a reddish-brown color, when they were put in close vessels and allowed to sour; when wanted they were steeped in water.

In the maritime districts the flour was mixed with salt water to economize salt.

In one kind of bread Pliny says, "they used a kind of chalk found in the hills between Naples and Puteoli, for imparting whiteness and crispness." There were no professional bakers in Rome until after the war with King Perseus, more than five hundred years after the city was built. The occupation originally belonged to women. Boaz said unto Ruth, "Eat of thy bread, and dip thy morsel in the vinegar." Vinegar was a regular ration issued to the Roman soldiery to dip their bread into.

After the conquest of Macedon, 148 B. C., Greek bakers came to Rome and monopolized the business. English bakers made bread with yeast in 1634. It was first made by machinery in England in 1858.

Aerated bread was made in the United States prior to 1859.

The bread making machine of Dauglish is mentioned favorably.

The largest sets of cracker machinery with oven of the present time will bake from 50 to 70 barrels of flour into crackers in 10 hours.

BREAD AND CRACKER MACHINES.

6,396 Bread and Cracker Manufactories in the United States.

	1860	1880
Capital Invested,	$3,909,189.00	$19,155,286.00
Value of Productions,	16,980,012.00	65,824,896.00
Wages Paid,	2,086,148.00	9,411,328.00
Hands Employed,	6,514	22,488

BREAD MACHINES.

Capacity—	Primitive Mode.	Present Machine.
Bbls. Flour Baked per day,	15	50
Hands Employed per day,	7½	7½

CRACKER MACHINES.

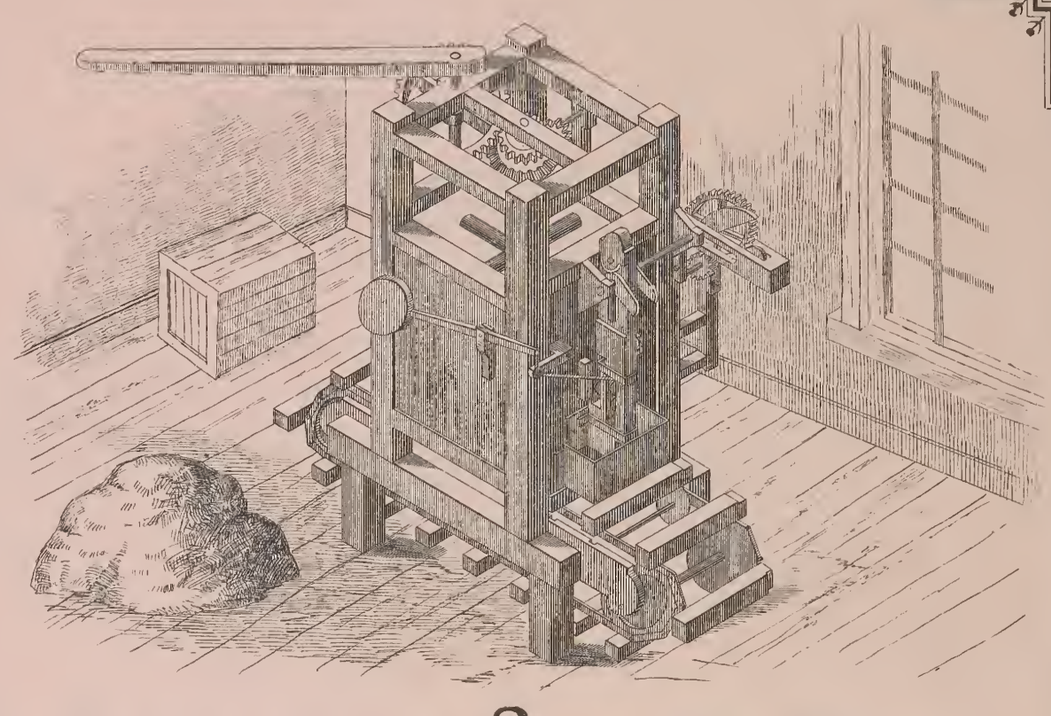
Capacity—	Primitive Mode.	Present Machine.
Bbls. Flour Baked per day,	6	50
Hands Employed per day,	6	6

372 Patents Granted by the United States.

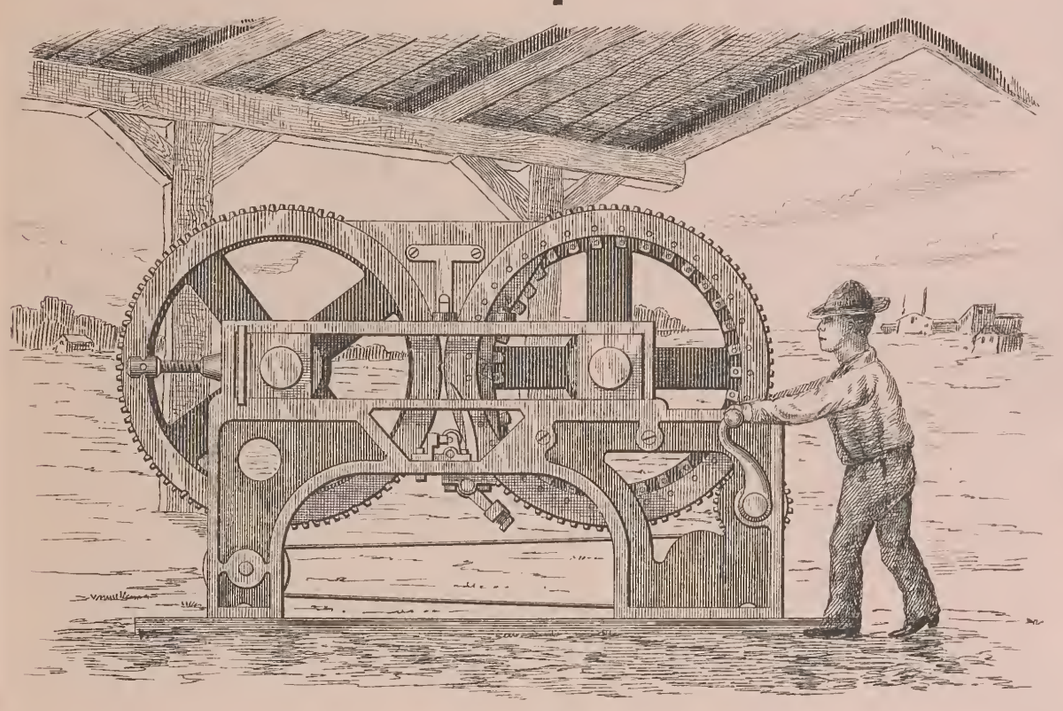
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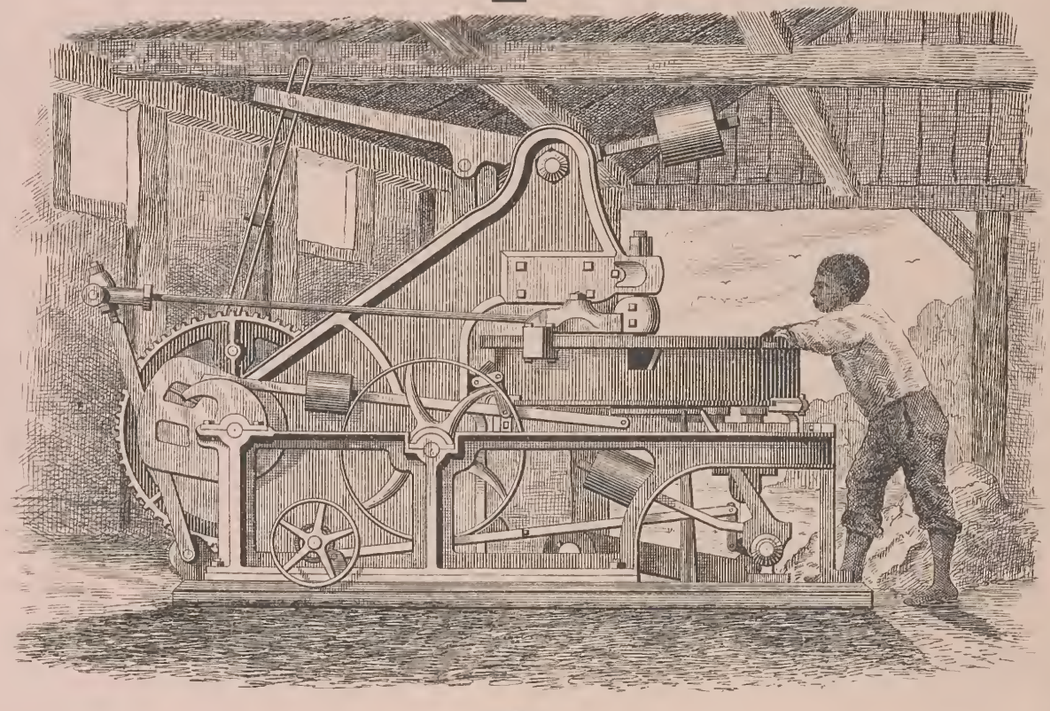
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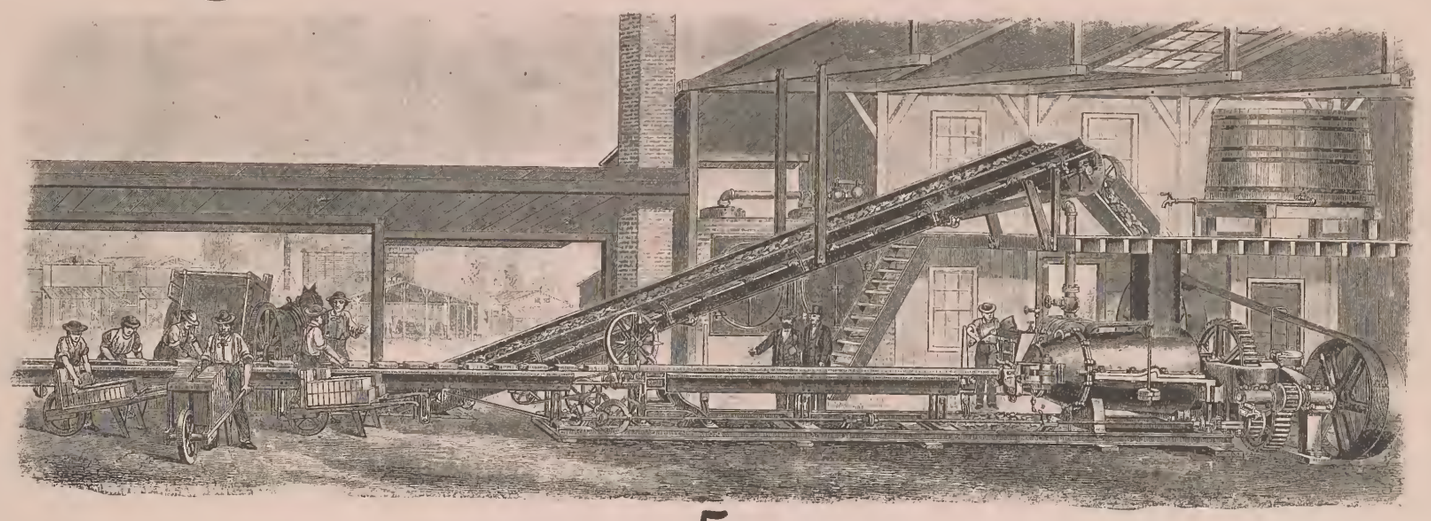
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BRICK MACHINES.

BRICK MACHINES.

No. 1. Primitive Egyptian.

2. U. S. Patent. Screw—A. D. 1841.

3. " " " Rotary—A. D. 1868.

4. " " " —A. D. 1883.

5. " " Screw and Plant—A. D. 1883.

Bricks are first noticed in the building of the tower of Babel: "And they said one to another, go to, let us make brick, and burn them thoroughly. And they had brick for stone, and slime had they for mortar." (Gen. xi, 3.)

Travelers on the Euphrates furnished accounts of the mounds of brick at the supposed site of Babylon.

The buried palaces of Nebuchadnezzer have for a long time furnished the brick for buildings erected in that section, there being scarcely a house in Hillah which is not built with them. His name was stamped on each brick used during his reign. Although these colossal structures fell to ruins, the materials remained, and were used to build later cities. In the walls of the modern city of Bagdad traces of that royal signature are to be found.

The Roman brick makers had their special marks. Roman bricks have been found in England.

Egyptian bricks were of the following proportions: Thothmes III, length 12 inches, width 9 inches, thickness $6\frac{3}{4}$ inches, weight $37\frac{12}{16}$ lbs. One in British Museum, length 11.3 inches, width 5.8 inches, thickness $6\frac{3}{4}$ inches, weight $13\frac{10}{16}$ lbs. One from the Pyramids, length 17 inches, width 8.8 inches, thickness 3.8 inches, weight $48\frac{6}{16}$ lbs.

Enameled bricks, brightly colored, are abundant in the mounds in Mesopotamia.

The mud of the Nile is the only material used in Egypt, and the modern process of making is the same as the ancient. Brick making in Egypt was a royal monopoly.

Strabo mentions brick made of earth so light that they floated in water.

The Romans used large, thin bricks.

Chinese potters work up the clay provided by their fathers, and lay up a store to ripen for their children.

Brick making in Greece was placed under legal supervision.

The Palaces of Cræsus, 548 B. C.; Mausolus, 325 B. C.; the Bath of Titus, A. D. 70; and the Pillar of Trojan, A. D. 98, were of brick.

The conquerors of Peru found brick making in a flourishing condition in the Empire of the Incas, and also in the more northerly countries of Yucatan and Mexico.

Bricks were made in England by the Romans, and under the direction of Alfred the Great, in A. D. 886.

The first bricks in the colonies were made in 1612.

The earliest brick kiln in New England was erected in 1629, at Salem, Mass.

The account books of the Patroon Van Renselear, show that yellow bricks, the product of the colony, sold for fifteen florins per thousand, between 1630 and 1646.

The Massachusetts Court, in 1667, appointed a committee to frame a law to regulate the size and manufacture of bricks.

William Penn's instructions to his agents, in 1684, were to build principally of bricks, for which end he sent a person qualified to make them.

The first United States patent for brick machines was granted George Hadfield, in 1800.

The manufacture by machinery was successfully commenced in the United States in 1829. Machine-made brick within the last ten years have taken the place of hand-made.

A brick machine, operated by twenty horse power, turns out twenty-five thousand bricks per day, and another makes fifty thousand every ten hours.

The finest pressed brick are made by machinery. Most of the Government buildings in the United States, which have been erected within the past few years, are faced with machine made pressed brick.

BRICK MACHINES.

5,631 Manufactories of Brick and Tile in the United States.

Manufactured in 1880.

Common Brick.	Fire Brick.	Pressed Brick.
3,822,362,000	163,184,000	210,815,000

	1860	1880
Capital Invested,	$7,130,128.00	$27,673,616.00
Value of Productions,	10,253,731.00	32,833,587.00
Wages Paid,	3,888,106.00	13,443,532.00
Hands Employed,	20,486	66,355

Capacity—	Primitive Mode.	Present Machine.
Number Bricks per day,	19,200	50,000
Hands Employed per day,	25	25

1,102 Patents Granted by the United States.

Seckell & Wilhelms Litho Co New York



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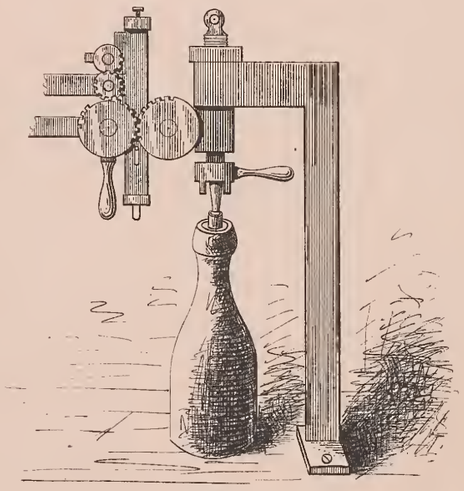
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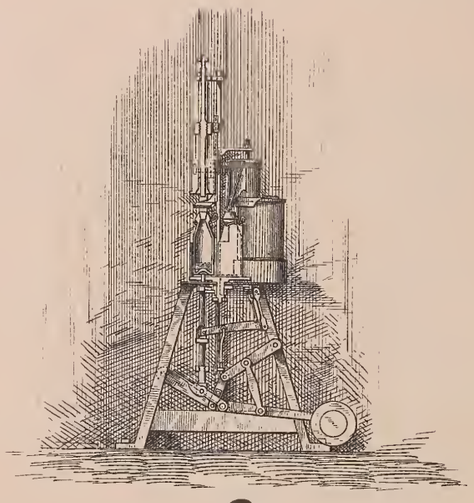
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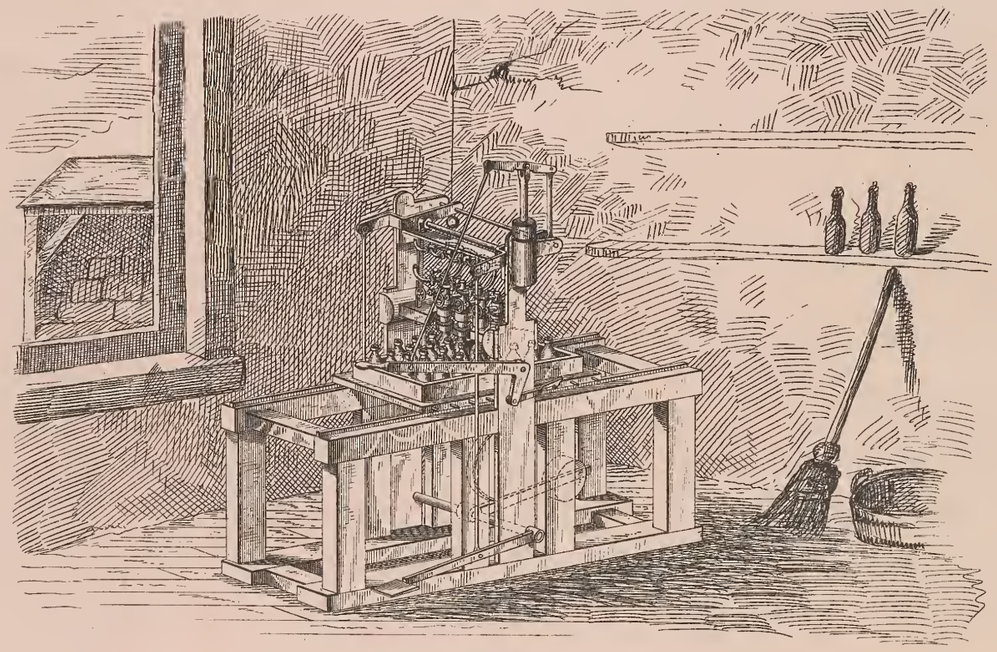
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7

BOTTLING AND FILLING.

BOTTLING AND FILLING.

No. 1. Primitive Bottle Filler.
2. " " "
3. Ancient Corking Machine.
4. " " "
5. U. S. Patent, Corker and Filler—A. D. 1856.
6. " " " " —A. D. 1862.
7. " " " " —A. D. 1883.

The bottles mentioned in the Bible were made of the skins of animals, and such vessels are still used for carrying water in Asia and Africa.

The Egyptians made their bottles of leather.

In Spain, wine bottles made of goat skins are used at the present time.

The glass used in the manufacture of bottles is of a coarse quality.

The siphon filling apparatus is for filling siphon bottles with aerated liquids.

Liquors are now bottled by machinery.

For ordinary bottling the machine is very simple; the bottle stands in a metallic cylinder, an inverted funnel depressed by a spring; the liquor is first introduced through a funnel, the cork then inserted in the vertical tube of the funnel, and driven through it into the bottle. A closed apparatus is used for charging bottles with liquor under pressure, such as those which contain carbonic acid gas, &c.

It is estimated that France uses annually over 60,000,000 bottles for wine alone.

SODA AND MINERAL WATER.

512 Manufactories in the United States.

	1860	1880
Capital Invested,	$585,860.00	$2,569,561.00
Value of Productions,	1,415,420.00	4,741,709.00
Wages Paid,	241,292.00	1,065,633.00
Hands Employed,	727	2,726

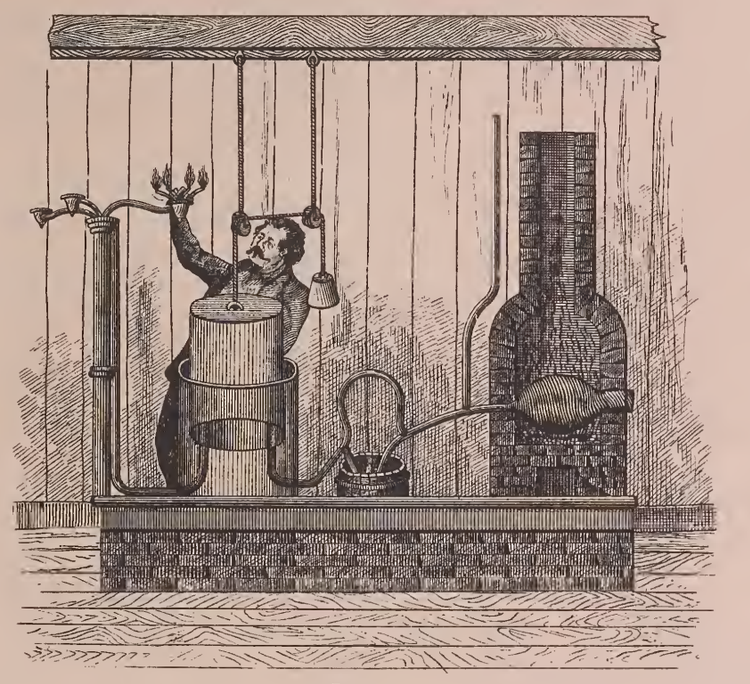
SUB CLASS.

BOTTLING AND FILLING.

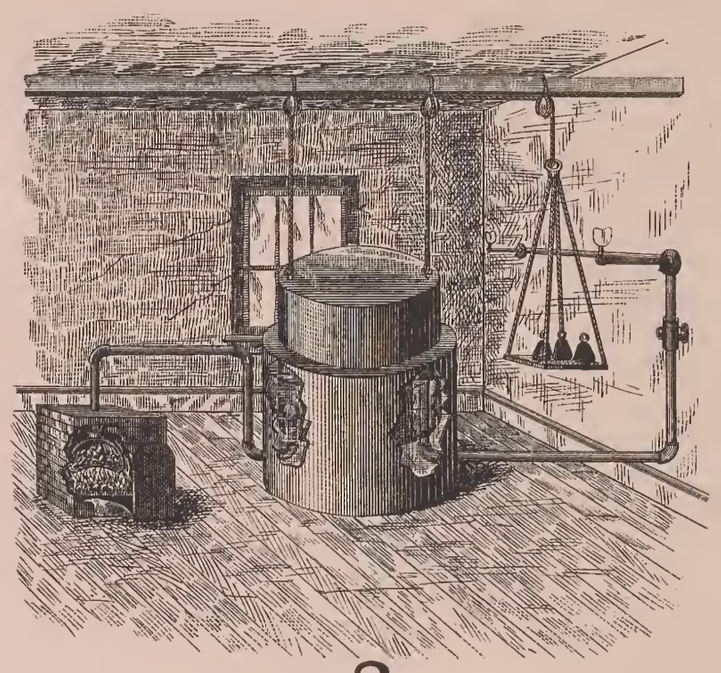
Capacity—	Primitive Mode.	Present Machine.
Dozens per day,	50	500
Hands Employed per day,	1	1

189 Patents Granted by the United States.

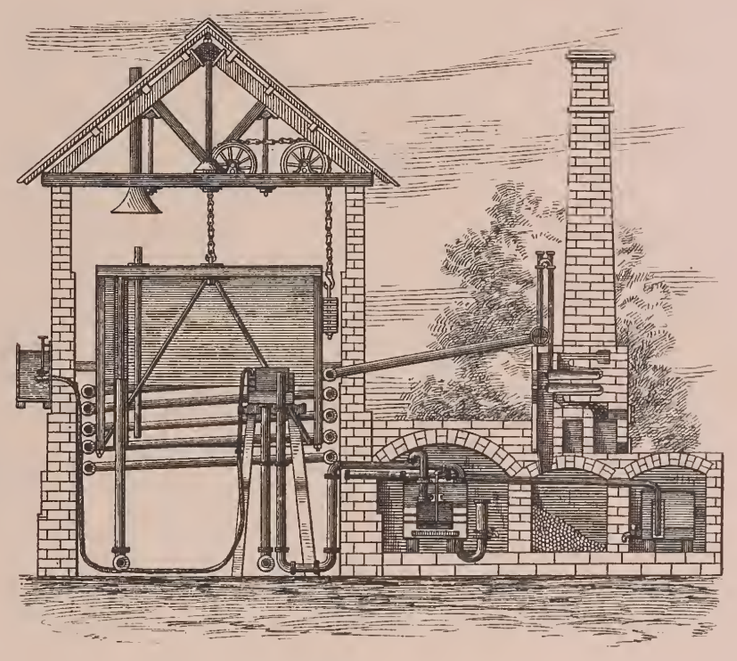
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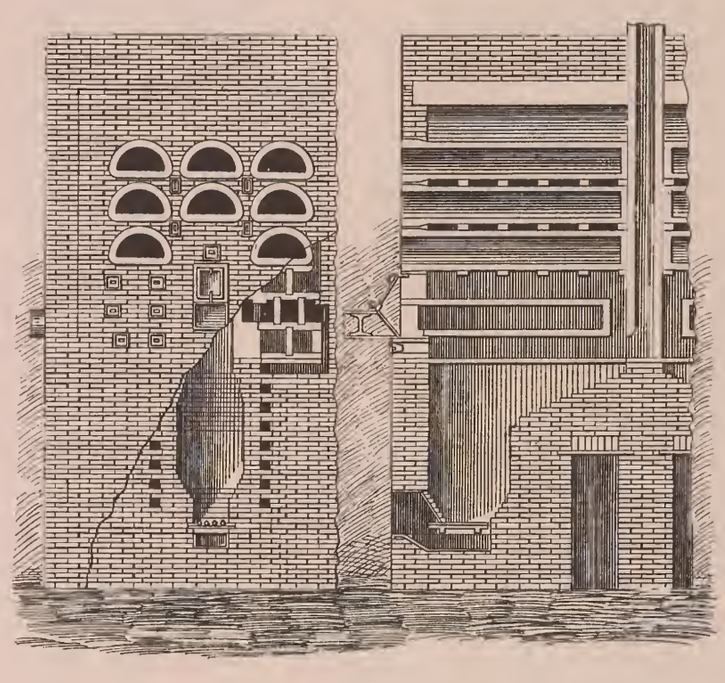
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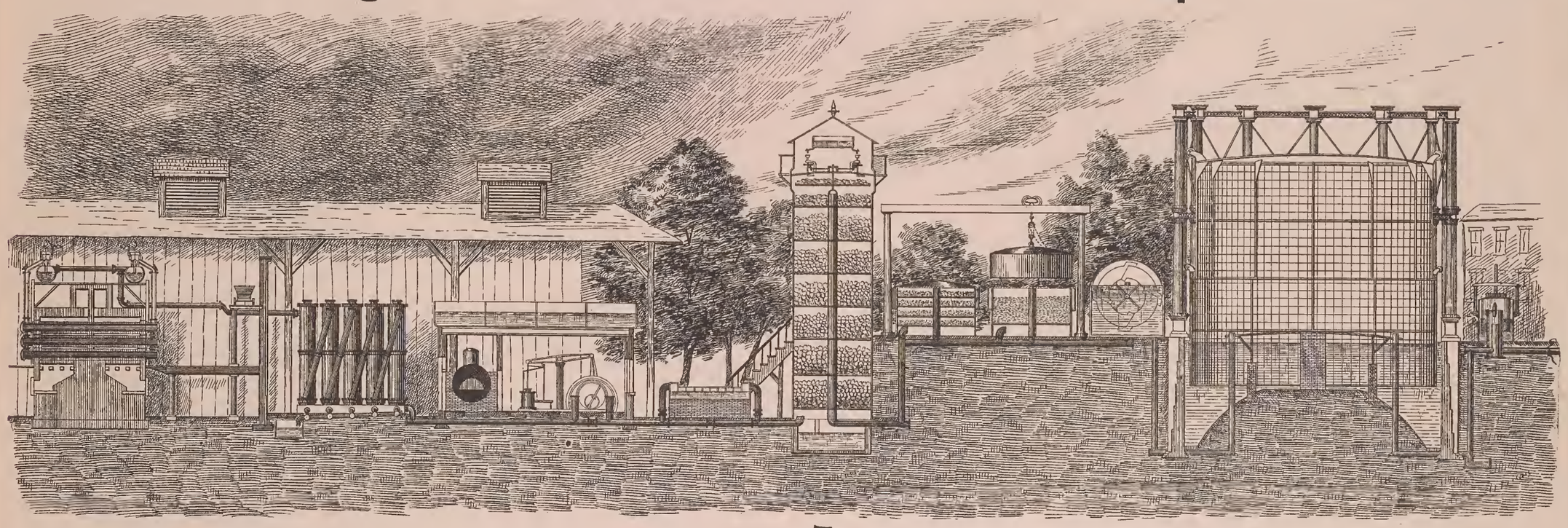
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COAL GAS MANUFACTURE.

COAL GAS MANUFACTURE.

No. 1. Primitive Gas Generator—A. D. 1805.

2. U. S. Patent, Gas Generator—A. D. 1813.

3. Gas Wnrks—A. D. 1815.

4. U. S. Patent, Regenerator Gas Retort Bench—A. D. 1882.

5. Complete Gas Works—A. D. 1884.

Lord Dundonald, of Scotland, took out a patent in 1787 for making coal gas. He also obtained a quantity of coal gas which was burnt in Culcross Abbey, and was considered a great curiosity.

The first street lighted with gas was Pall Mall, London, in the spring of 1807, and the first gas company established was chartered. Its title was originally intended to have been "The Grand National Light and Heat Company for Lighting and Heating the Whole Kingdom." Its originator was Mr. Winsor, who witnessed his sublime scheme dwindle to the more simple and practical plan of lighting the cities of London and Westminster and the borough of Southwark. Mr. Winsor is generally supposed to have been the original inventor of gas; but the engineer, who also invented the first plan of a steam locomotive engine, Mr. William Murdock, a Scotchman, preceded everybody else in the application of coal gas to illumination.

In 1792 he began experiments and found that when coal was heated in an iron retort an inflammable gas was given off, and with this gas he lighted his residence.

In 1809 Mr. Murdock was examined by a Parliamentary committee, when a member asked the question: "Do you mean to tell us that it will be possible to have a light without a wick?" "Yes, I do, indeed," said Mr. Murdock. "Ah! my friend," said the legislator, "you are trying to prove too much." This is about a fair specimen of the fate of the men who have introduced light into this prejudiced world.

Gas was introduced in the United States at Baltimore, Md., in 1821, at Boston in 1822, and in New York in 1827.

The best coal for gas manufacture is Boghead, Parrot and Cannel.

The following different volumes of gas have been obtained from various kinds of coal: Cannel coal, 15,000 cubic feet; Wigan cannel, 15,426; Boghead cannel, 13,334; Cape Breton, "Cow Bay," etc., 9,500; Pictou and Sydney, 8,000; English mean, 11,000; Newcastle, from 9,500 to 10,000; Pittsburgh, 9,520: Scotch, from 10,300 to 15,000; Wallsend, 12,000; Virginia, 8,960; Western, 9,500. Pine wood will evolve 11,000 cubic feet per ton; resin, 15,600; oil and grease, 23,000 cubic feet.

Each retort should produce about 600 cubic feet of gas in 5 hours, with a charge of 1½ cwt. of coal, or 2,800 cubic feet in 24 hours. One ton of coal should produce about 9,000 cubic feet of gas, 1 chaldron of coke, and about 11 gallons of tar, and 9 ammoniacal liquor.

Dry purifiers require 1 bushel of lime to 10,000 cubic feet of gas; and wet purifiers an admixture of water 48 bushels and lime 1 bushel for each 10,000 cubic feet of gas.

One per cent. of carbonic acid in gas diminishes its illuminating power one-tenth.

Defective burners should be changed without delay, as all smoking, roaring, irregular, ragged and pronged flames cause a great waste of gas with deficient light.

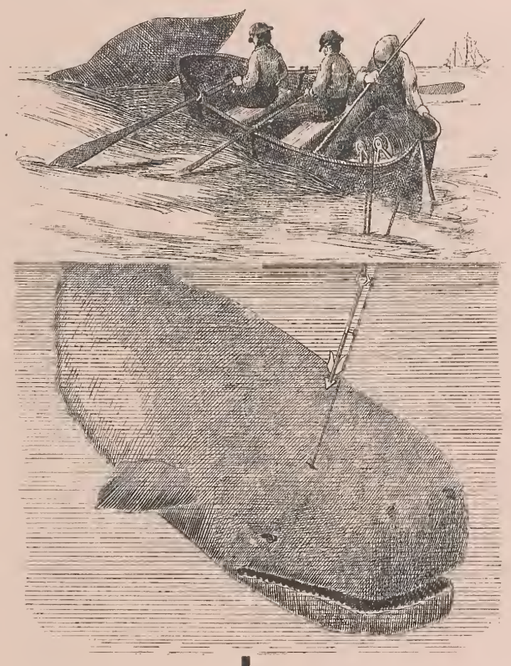
A smoky flame indicates loss of gas as well as loss of light.

COAL GAS MANUFACTURE.

Capacity—	Primitive Mode.	Present Machine.
Cubic Feet per day,	10,000	30,000
Per cent. of Fuel Saved in Heating.		.30

1,892 Patents Granted by the United States.

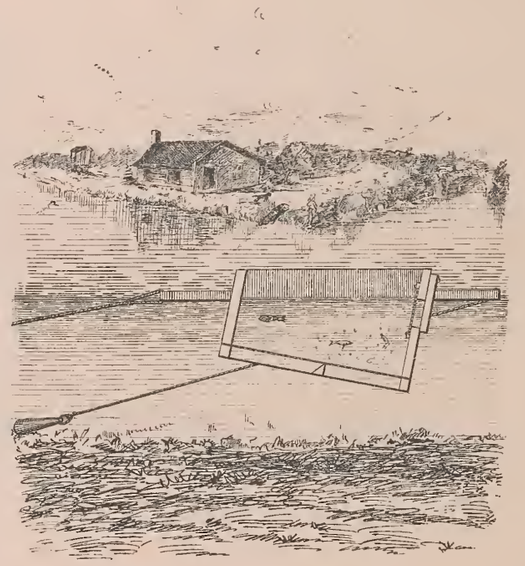
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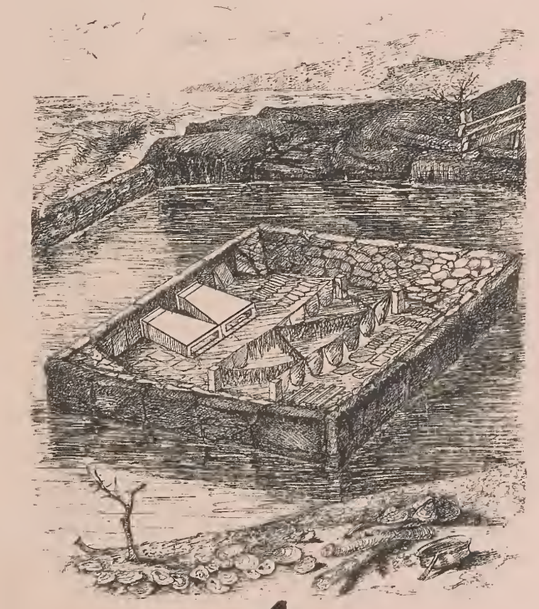
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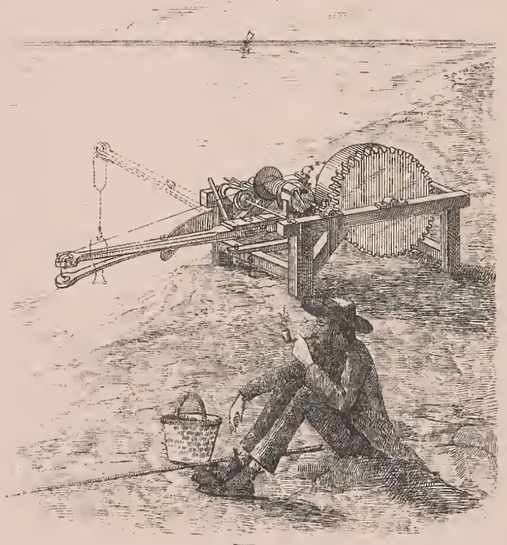
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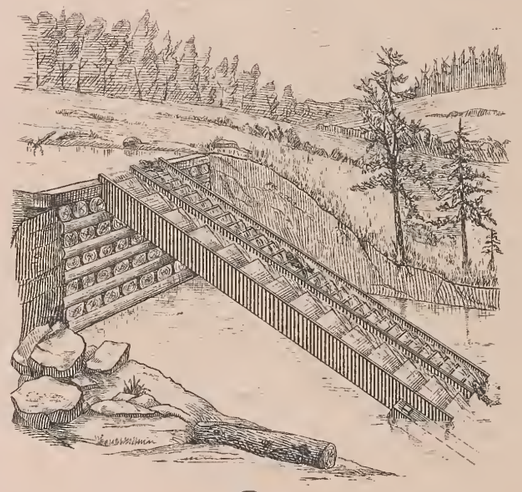
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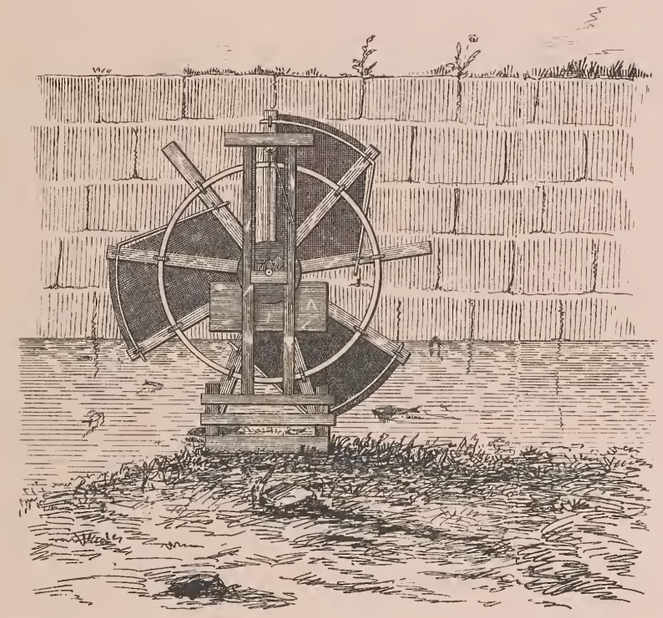
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FISHING.

FISHING.

No. 1. U. S. Patent, Harpoon—A. D. 1862.
2. " " Fishway—A. D. 1866.
3. " " Hatcher—A. D. 1867.
4. " " Oyster Nursery—A. D. 1872.
5. " " Automatic Reel—A. D. 1878.
6. " " Fishway—A. D. 1879.
7. " " Current Wheel—A. D. 1881.
8. " " Oyster Dredge—A. D. 1883.

Among the ancients, fisheries were carried on extensively, and formed a valuable branch of industry.

The favorite fish of the Romans was caught in great abundance in the sea around Sicily.

The fisheries of Egypt were celebrated, but were all inland in lakes, canals, and the River Nile. The revenues arising from the fisheries of Lake Moeris were given to the Queen of Egypt for pin money, and are said to have amounted to $470,000 annually.

The earliest mention of the herring fishery dates from A. D. 709.

The discovery in the fifteenth century of Newfoundland and its fisheries gave the greatest impulse to the business.

The French were the first Europeans who engaged in the American cod fishery. The first English voyagers in quest of fish came to America in 1517.

At the beginning of the seventeenth century it is estimated that two hundred English ships went annually to Newfoundland, and that they employed not less than ten thousand men and boys in catching and curing fish.

Capt. John Smith, in 1614, on the coast of Maine, took and dried, or pickled, forty-seven thousand fish, the profits from which, and from the furs he bought of the Indians, amounted to seven thousand dollars.

In 1670 the profits of the fisheries of Cape Cod, Mass., were granted to found a free school.

In 1852 serious troubles broke out on the fishing grounds between American fishermen and the British authorities; in 1854 a reciprocity treaty was agreed upon.

The Egyptians use fish skins for soles of shoes, and the inhabitants of the eastern coast of Central Asia clothe themselves with the tanned skin of the salmon. The skins of sharks and allied fishes are largely employed, under various trade names, for polishing woods and for coverings for boxes, cases, &c.

The census of 1880 shows that one hundred and thirty-one thousand four hundred and twenty-six men were employed in the fisheries of the United States.

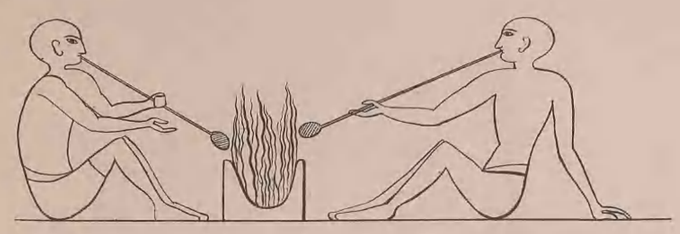
FISHING.

Statistics of the Fisheries in the United States in 1880.

	1880
Capital Invested,	$37,955,349.00
Value of Productions,	43,046,053.00
Hands Employed,	131,426
Vessels Employed.	
Number,	6,605
Tonnage,	208,298
Value,	$9,357,282.00
Boats Employed.	
Number,	44,804
Value,	$2,465,393.00

412 Patents Granted by the United States.

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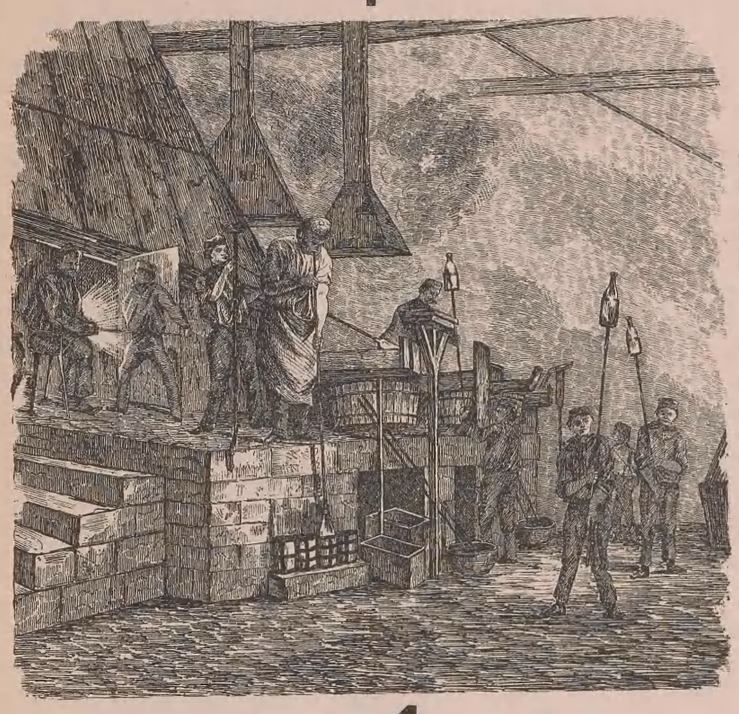
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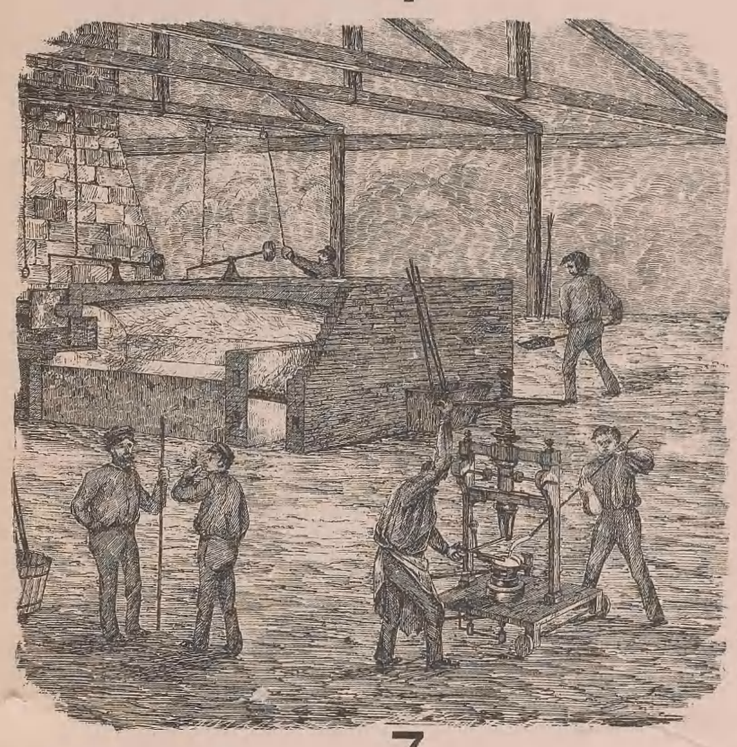
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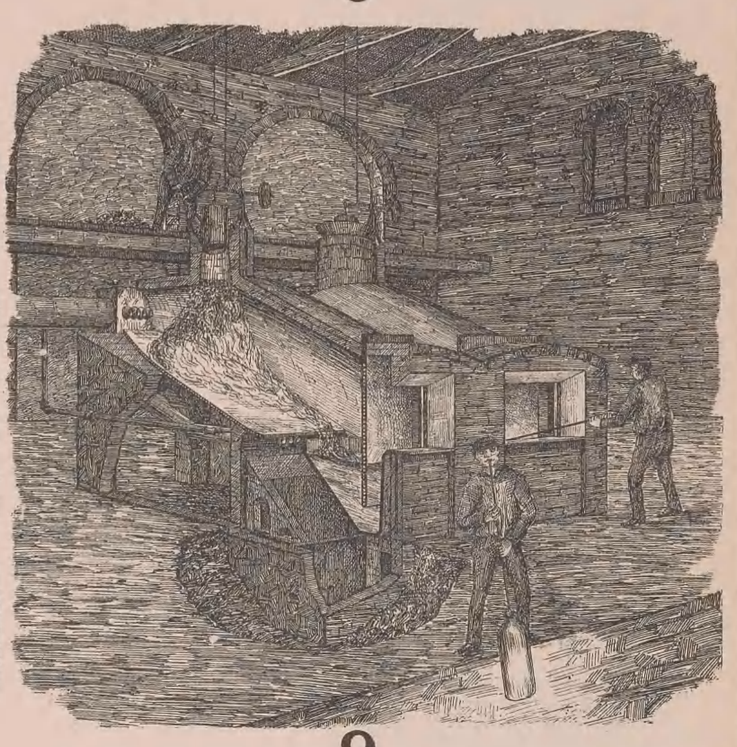
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GLASS MAKING.

GLASS MAKING.

1. Primitive Egyptian Glass Blowers.
2. Glass Furnace, 17th Century.
3. Pot Furnace.
4. French Bottle Making—A. D. 1876.
5. U. S. Patent, Regenerator Furnace—A. D. 1872.
6. " " Machinery for Handling Blow Pipes—A. D. 1880.
7. " " Oval Tank Furnace—A. D. 1880.
8. " " Blowing Bottles into Molds—A. D. 1883.
9. " " Continuous Furnace—A. D. 1884.

The earliest accounts of glass-making attribute its manufacture to the inhabitants of Tyre and Sidon.

Glass-making appears to have been known in Egypt before the year 1800 B. C.

The Egyptians were not only acquainted with glass-making, but knew how to stain it of various colors.

The art of depriving it entirely of color and rendering it as transparent as crystal was a subsequent improvement.

Glass was introduced into India by the Europeans, and it is said that the Chinese to this day are only able to make glass vessels out of broken glass made in Europe.

In the third century articles of glass were in common use.

The first positive allusion to the use of glass in windows was made by Lactantius near the close of the third century.

The Venetians were the first Europeans who excelled in the manufacture of glass.

One Benault brought the art into England.

In the year 1567 the glass casements of Alnwick Castle were only put in when the proprietor visited the place, and were taken out and put aside for safety when he was absent.

In Scotland as late as 1661 the windows of ordinary houses were not glazed, and only the King's palaces could boast of this advantage.

There are four kinds of glass in common use, flint, window, plate, and bottle, or common green.

Mirrors of glass were first manufactured by the Venetians.

Colored glass is perhaps as ancient as the material. Egyptian mummies are found decorated with colored glass beads, which must be three thousand years old.

Plate glass was made by Venetian artists in 1673.

The British Plate Glass Co. was established in 1773.

James Chase perfected the process of grinding and polishing sheet glass.

Glass cutting was invented at the beginning of the seventeenth century by Casper Lehman.

One of the first attempts at manufacturing, within the limits of the thirteen original colonies, was the production of glass.

The vessel which brought Captain Newport to the colony of Virginia on his second voyage in 1608, also brought eight Poles and Germans to make pitch, tar, glass, etc.

Between the arrival of Captain Newport and the return of his vessel in 1608 or 1609, some glass was made, and part of the return cargo, the first that conveyed any exports of manufactures from what is now the United States of America, was the trials of glass thus made.

The house in which the glass was manufactured stood in the woods about a mile from Jamestown, Va., and it is supposed clear glass bottles only were made. The next account of glass works in Virginia is of one in existence in 1787, at Alexandria.

In 1796 preliminary steps were taken toward the erection of a glass house at Pittsburgh, Pa.

The first attempt to manufacture flint glass, west of the Alleghanies, was made in Craig & O'Hara's window glass furnace in September, 1800, at Pittsburgh, Pa.

In 1808 Mr. Thomas Bakewell and Mr. Page purchased the works of Robinson and Ersell, of Pittsburgh, Pa., and to Mr. Bakewell is accorded the honor of erecting and operating the first successful flint glass house in the United States.

About 1853 the first plate glass manufactory in the United States was established in Cheshire, Berkshire Co., Mass.

At the Paris Exposition, in 1878, a bonnet was exhibited made entirely of glass, as well as cloaks and other articles of apparel.

The chief establishments for the manufacture of flint glass in the United States are at Pittsburgh, Pa., Sandwich, Mass., and Brooklyn, N. Y.

Pittsburgh has 72 glass factories; 22 are devoted exclusively to the manufacture of window glass, the remaining 50 to bottle glass, table ware, lamp chimneys, etc.

The work of the best of the window glass factories in the United States is considered equal to any foreign product.

Fully 5,000 persons are engaged in this branch of the glass industry, and the annual product is not less than 800,000 fifty-foot boxes a year.

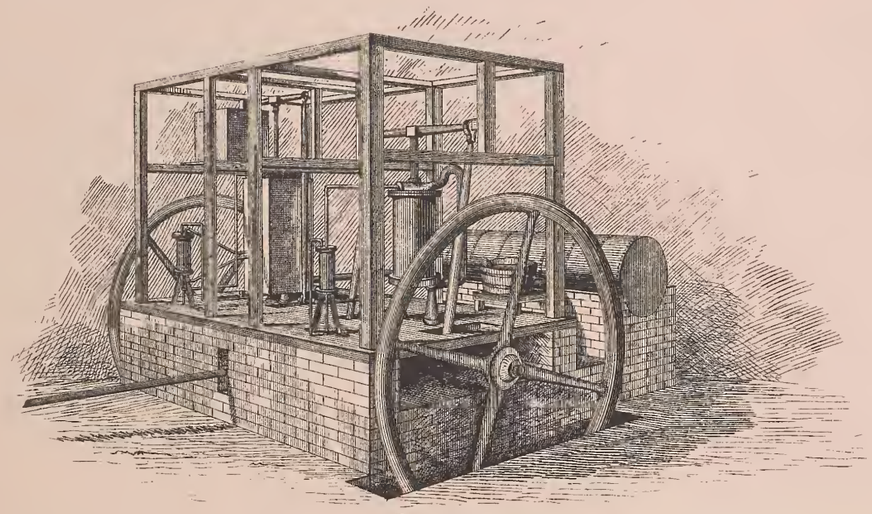
GLASS MAKING.

211 Manufactories in the United States.

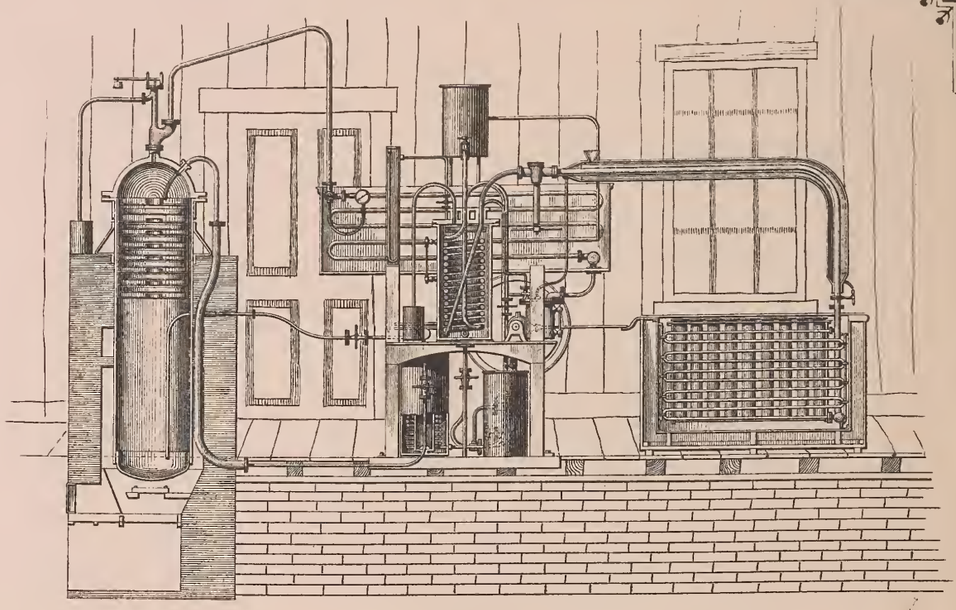
	1860	1880
Capital Invested,	$6,133,666.00	$19,844,699.00
Value of Productions,	8,775,155.00	21,154,571.00
Wages Paid,	2,903,832.00	9,144,100.00
Hands Employed,	9,016	24,177

950 Patents Granted by the United States.

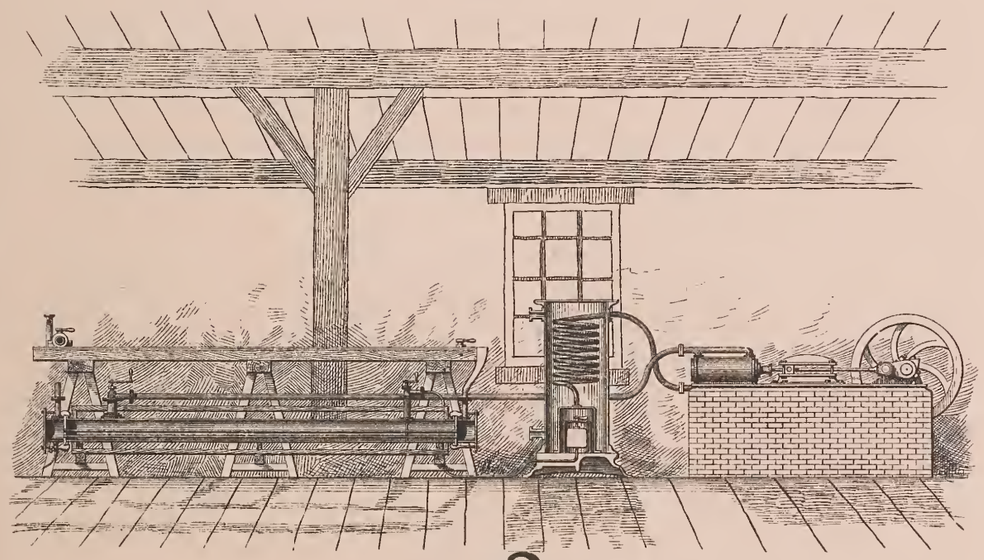
Sackett & Wilhelms Litho Co New York



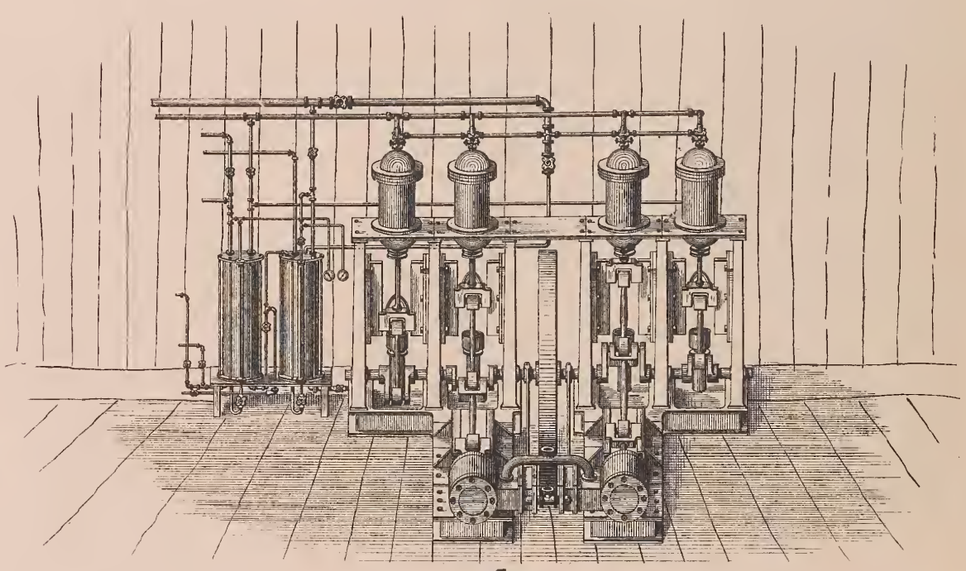
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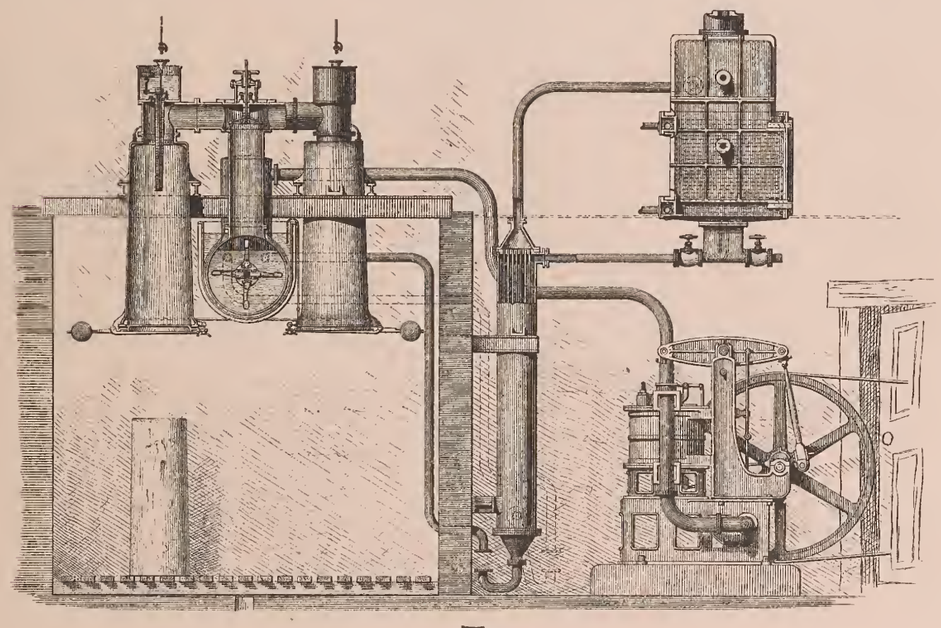
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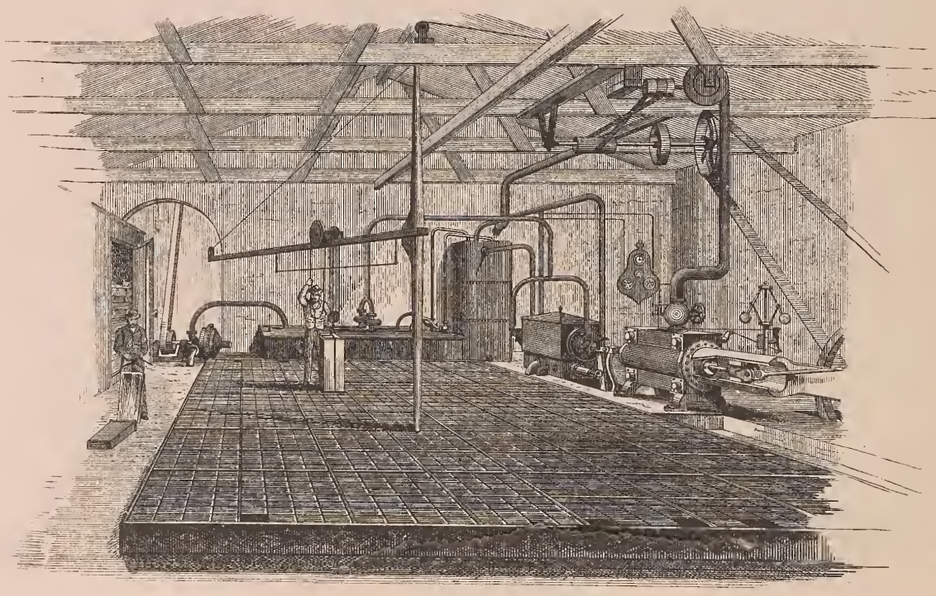
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6

ICE MACHINES.

ICE MACHINES.

No. 1. U. S. Patent, Compressed Air—A. D. 1851.
2. " " Ammonia--A. D. 1865.
3. " " Liquefied Ammonia—A. D. 1869.
4. " " Compound Liquid—A. D. 1881.
5. " " " " —A. D. 1881.
6. " " Ammonia Plant—A. D. 1882.

In the book of Proverbs we read "As the cold of snow in the time of the harvest, so is a faithful messenger to those who send him, for he refreshes the soul."

The ancient Greeks and Romans were accustomed to cool their liquors by means of ice or snow.

The ancients had a method of cooling water by first boiling it, and then placing it in porous vessels in the air, the outsides of which were kept continually wet.

The use of saltpetre for cooling liquids was known and practiced at a remote period in India.

Freezing water by a mixture of snow and saltpetre is mentioned by Tancrelus in 1607.

Santono, in 1626, speaks of freezing wine by a mixture of snow and common salt.

Champrer, the physician of Francis I, mentions the injurious custom of the Spaniards of putting ice and snow in their liquors.

Iced fruits were brought to the table in Italy in the beginning of the 17th century. Soon after, the art of congealing cream was discovered.

The natives of India have a method of producing ice by exposing shallow, porous vessels laid on straw to the night air, which gives a small crust of ice; that is taken away and carefully deposited in a pit lined with straw, before sunrise.

An artificial mode of making ice, by a mixture of saltpeter and snow, is mentioned by Lord Bacon.

A method of producing ice by extracting the air from the water, by means of an air pump, was discovered about 1825.

Ice is now made in large quantities either by evaporation or sudden reduction of temperature.

Carre's machines were all based on the principle of vaporization.

Most of the present American, English and German machines are upon the principle of reduction of pressure.

By the use of ice making machines, ice can now be furnished to the inhabitants of hot climates, where ice was previously unknown. Machine made ice has the same valuable qualities of lake or brook ice, so that it can be used for drinking and other purposes.

ICE MACHINES.

35 Manufactories in the United States.

	1860	1880
Capital Invested,	None.	$1,251,200.00
Value of Productions,	"	544,763 00
Wages Paid,	"	140,885.00
Hands Employed,	"	447

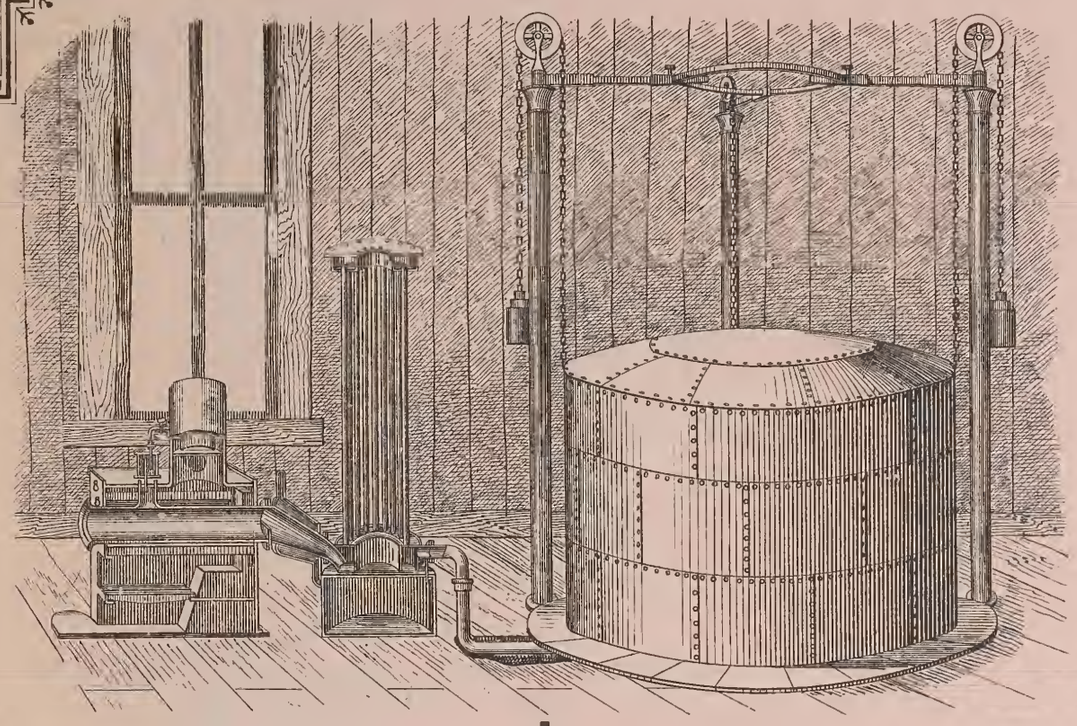
SUB CLASS.

ICE MACHINES.

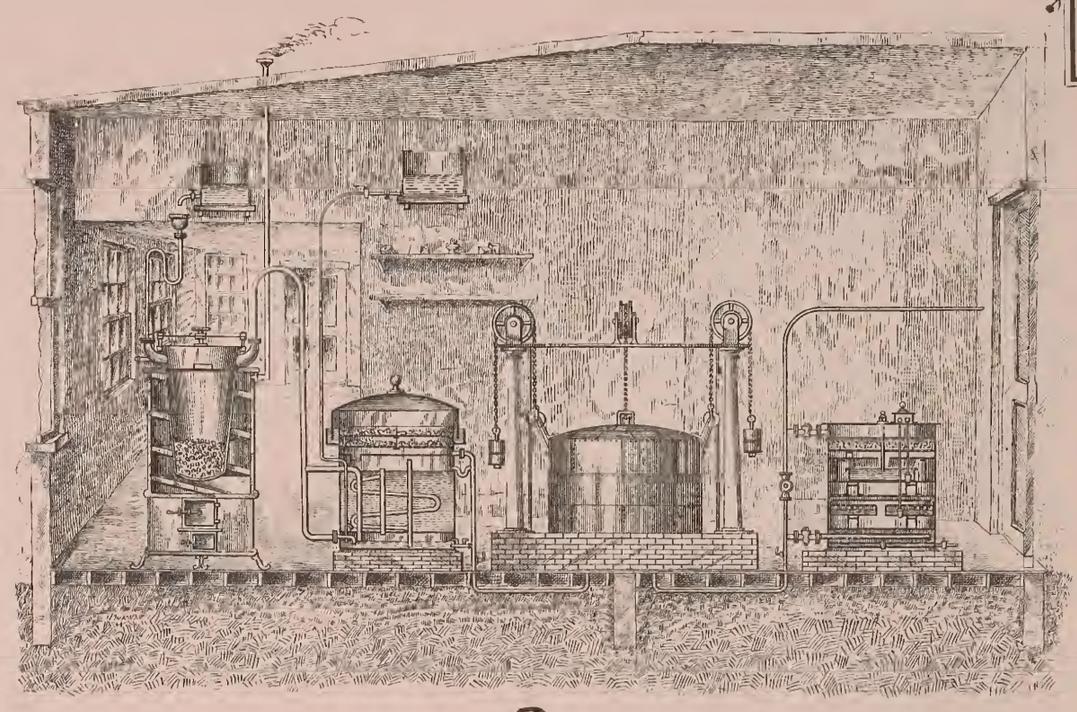
Capacity—	1880 Present Machine.
Tons Ice Manufactured per day,	75
Hands employed per day,	10

300 Patents Granted by the United States.

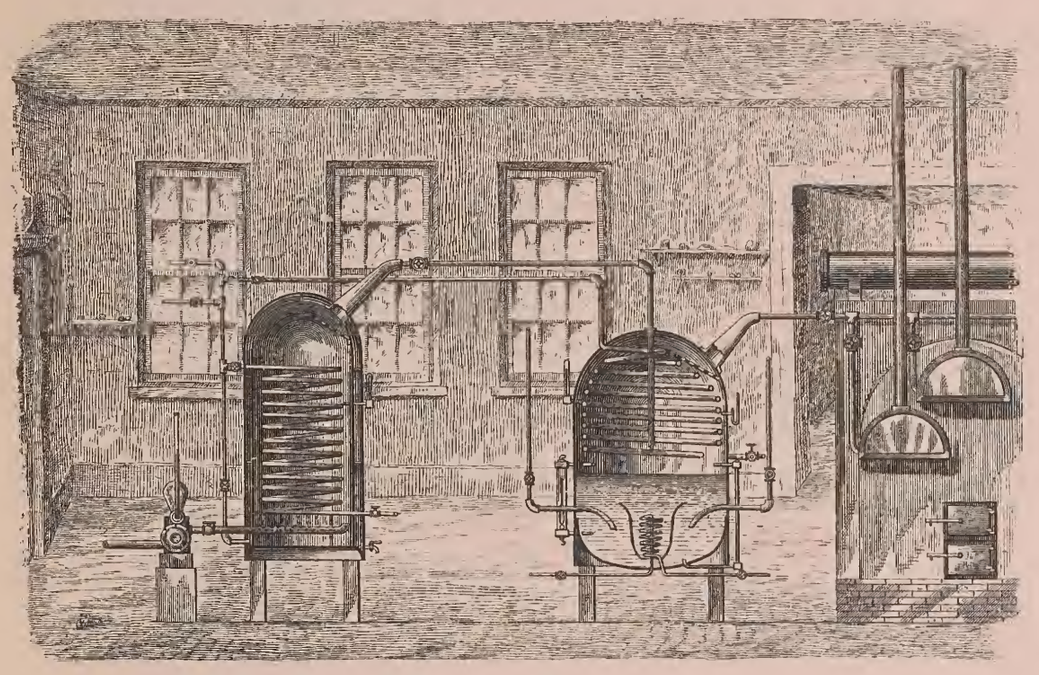
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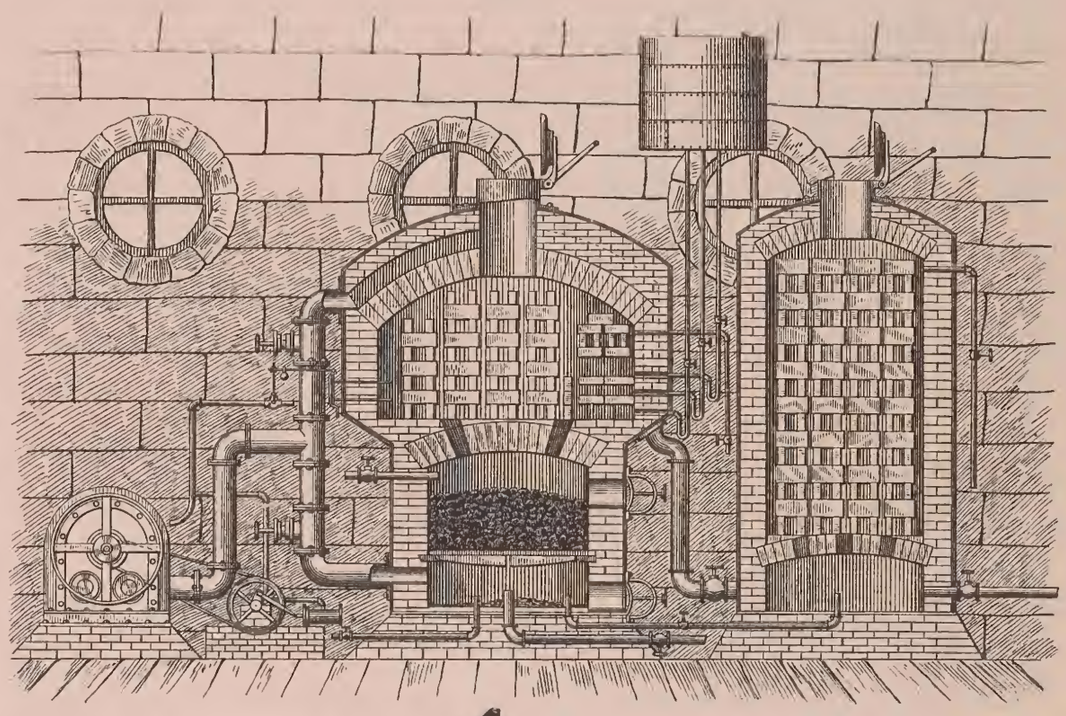
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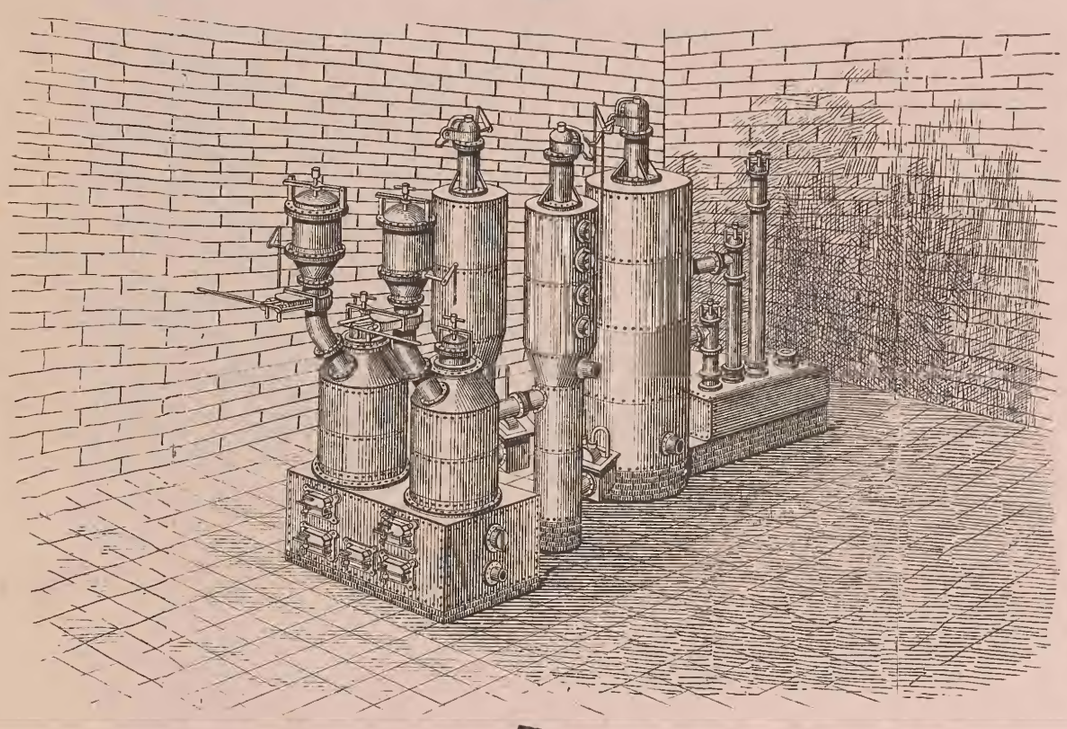
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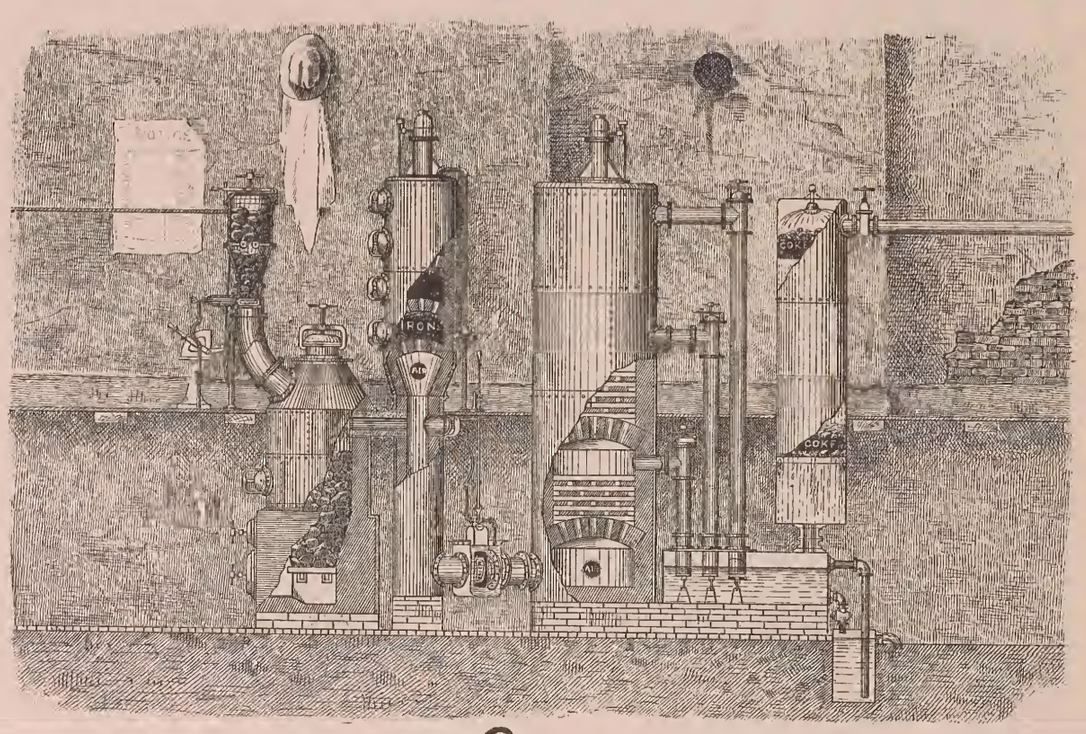
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OIL GAS MANUFACTURE.

OIL GAS MANUFACTURE.

No. 1. U. S. Patent, Gas Generator for Oil or Resin—A. D. 1845
2. " " Domestic Oil Gas Works—A. D. 1872.
3. " " Oil Gas Generating Apparatus—A. D. 1875.
4. " " Gas Generating Apparatus—A. D. 1882.
5. " " " " " —A. D. 1884.
6. " " " " " —A. D. 1884.

Dr. Henry distilled gas from oil in 1805.

Taylor, in 1815, distilled gas from refuse and fatty matters, and obtained a patent for his process the same year. The apparatus which he used consisted of a furnace and retort, the latter being charged with coke on whose heated surface the oil drips continuously from a reservoir.

The first attempts to introduce gas in the United States were made in baltimore, Md., from 1816 to 1821.

In 1822 it was introduced into Boston, and in the year 1823 the first gas company in the United States was formed, and called the New York Gas Company. It commenced operations with a capital of $1,000,000. So limited, however, were the demands, or so slow were the people to take to the new material, that the company was not in active successful operation until 1827.

Rosin and oil were used for its manufacture until 184[illegible].

Gas is manufactured from wood, peat, petroleum and water.

Natural gas has, by recent trials, been demonstrated to be the best and most economical for use in many branches of industrial art.

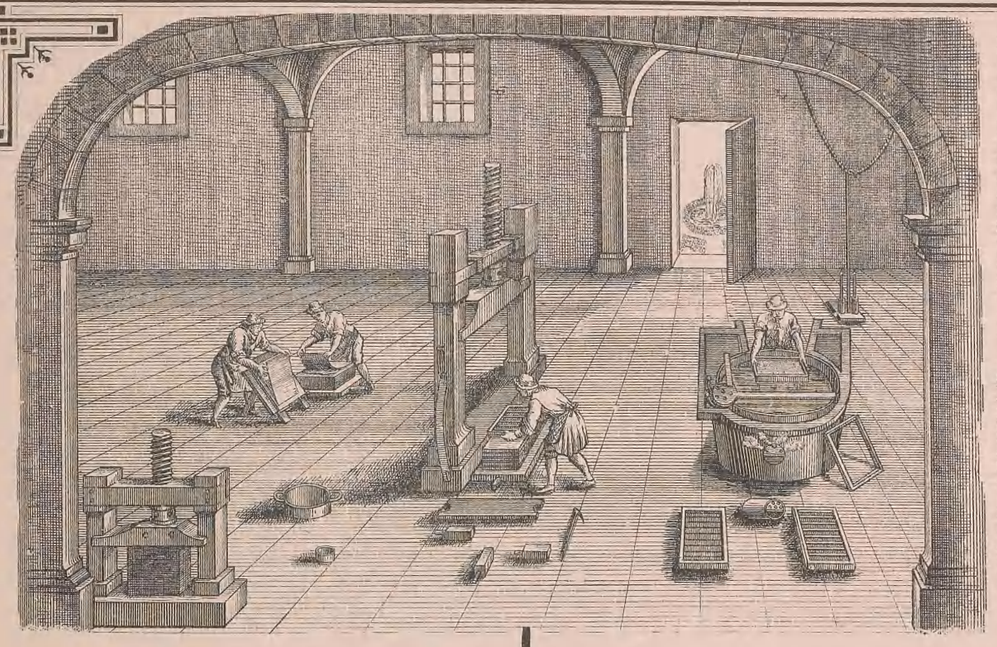
It is quite extensively used for, manufacturing purposes.

It makes superior glass, and turns out a larger and improved product in the puddling furnace.

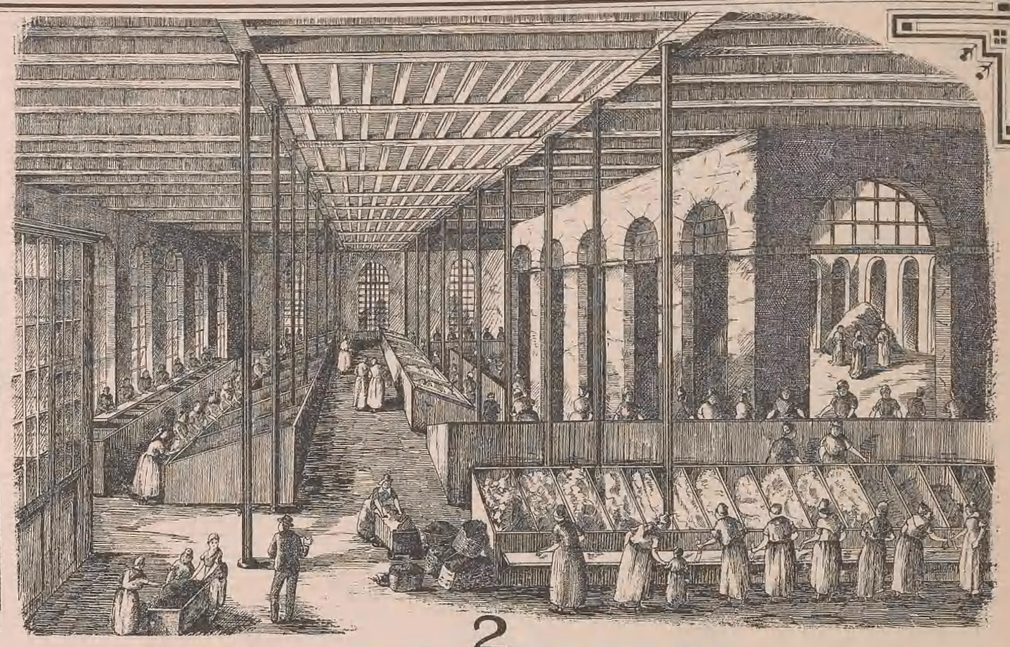
OIL GAS MANUFACTURE.

1,892 Patents Granted by the United States.

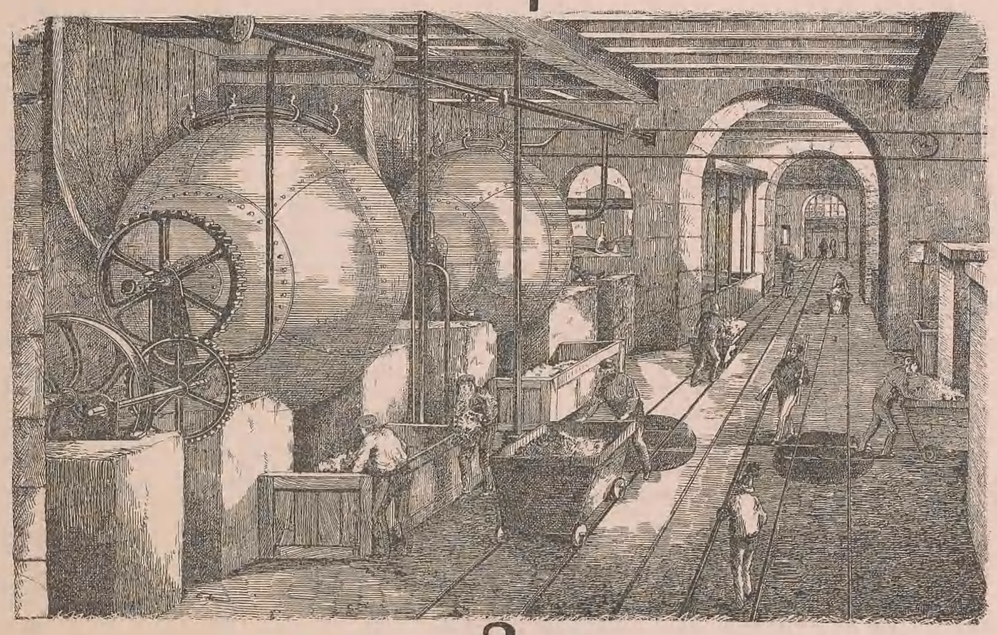
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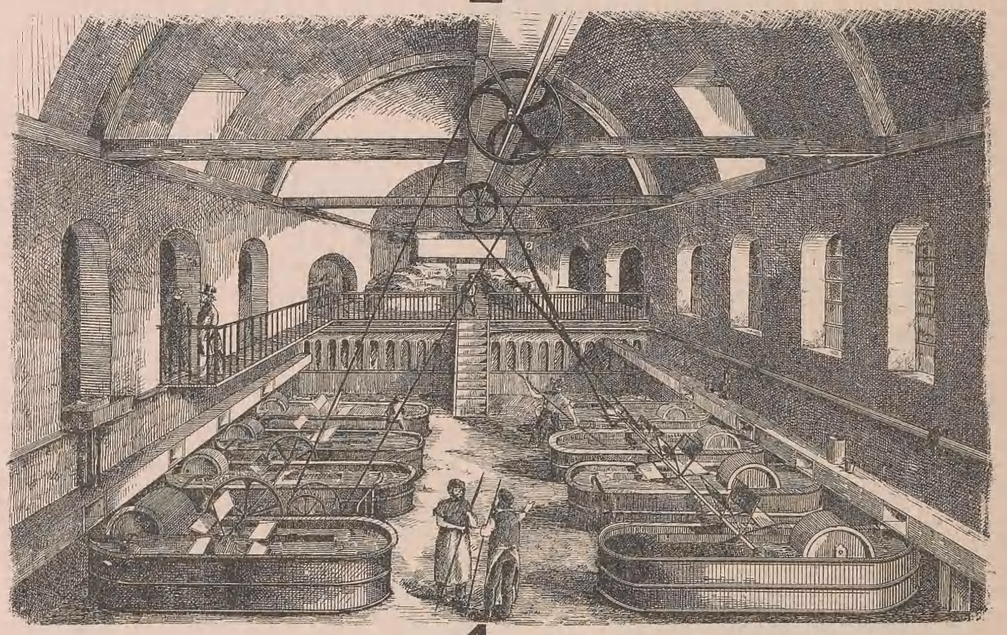
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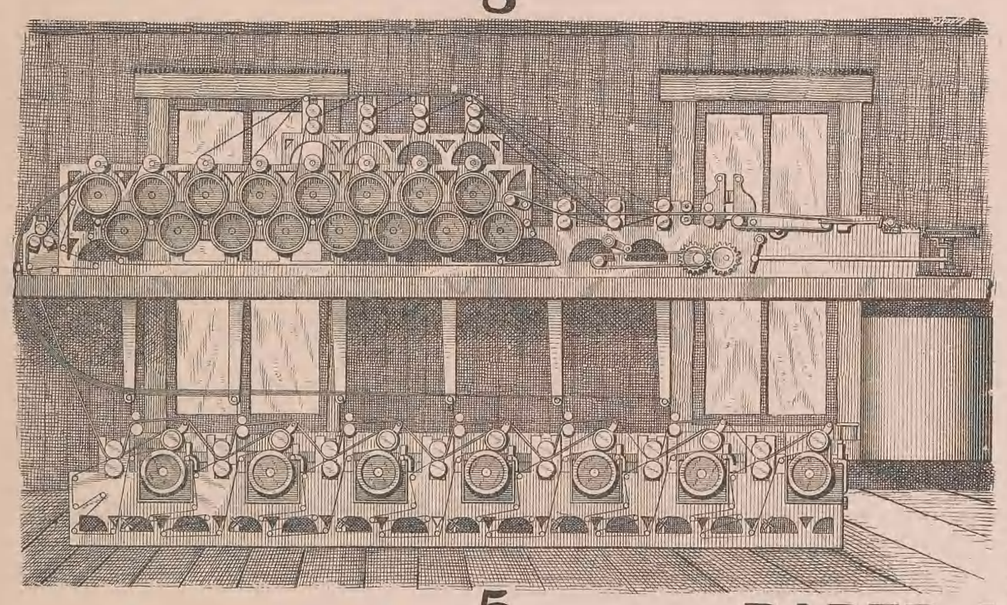
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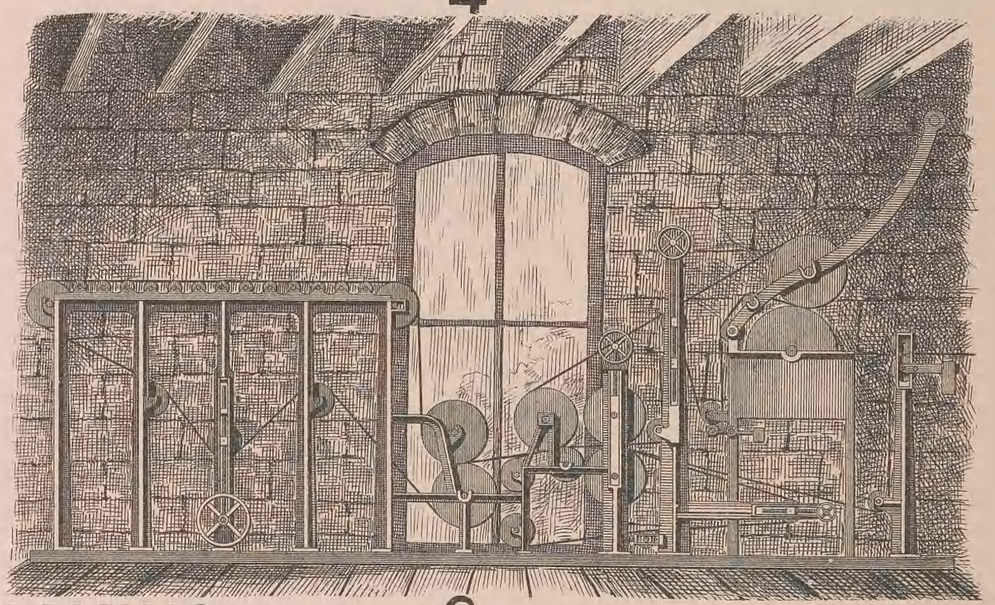
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6

PAPER MAKING.

PAPER MAKING.

No. 1. Primitive Hand Machine.

2. French Cutting and Assorting.

3 " Digester and Boiler.

4. " Beating.

5. Cylinder Paper Machine—A. D. 1859.

6. U. S. Patent, Cylinder Paper Machine—A. D. 1870.

The origin and history of paper can be traced to the early days of the Egyptians and Hebrews.

The first paper was made from the papyrus plant. Isaiah, in the Old Testament, predicted the extinction of this plant. Homer and Herodotus called this plant or reed "biblios."

Varro, a Roman writer of the first century B. C., claimed that the discovery of the papyrus or paper tree was made during the expedition of Alexander of Macedon into Egypt, 356 B. C. This statement is contradicted, as Egyptian tombs show that it was used many ages before the time of Alexander. Some writers claim its existence as far back as the stone records of Egypt, 2400 B. C. Pliny says that "the papyrus grew in the lowlands and marshes of Egypt, to the height of 12 to 15 feet."

The chief source of supply was from Egypt. To the Egyptians, therefore, we are indebted for the discovery of paper from plants or trees.

The valuable libraries, destroyed during the siege of Alexandria by Cæsar, B. C. 47, were partly on parchment.

The library, presented by Marc Antony to Cleopatra, was written largely on parchment, as a prohibition had been laid on papyrus from Egypt, by the Ptolemies, who resented any rivalry in libraries.

Eumenes claimed the discovery of parchment, 200 B. C. A mode of preparing and dressing the skins of animals can only be claimed for him, as the Hebrews had used skins for records many ages before.

The public documents of France, under Charlemagne, were written on parchment, except those of the Pope, who used papyrus, until the twelfth century.

In Japan, previous to the year A. D. 280, silk with linen facing was used for writing.

Paper proper was first introduced by the Saracens, an Arabian tribe, whose origin and location rest in obscurity. In the eighth century they conquered Spain, and through them the art of paper making reached other portions of Europe. The Spaniards first made paper of flax, afterward of cotton.

A great change took place when paper was made of rags, cotton, linen, flax fiber, and various other articles. Paper used by the Chinese prior to the Christian era is supposed to have been made of silk. The Bamboo fiber paper is very ancient. Chinese rice paper is made from the inner portion of the stems of a hardy plant found around the lakes in British India, whence the Chinese import it. Its mode of manufacture is similar to that of the Egyptian papyrus.

A. D. 1050, the Christians in Spain made paper of rags. A specimen has been found bearing date 1109. Twelve years later the King of Sicily granted a charter to "makers of paper." In 1151 a superior quality of paper was made in Spain from raw cotton and rags, by the aid of a water mill, the first known application of machinery for this purpose.

In 1170 papyrus fell into disuse. Flax paper was also made in this year.

The oldest manuscript in existence, written on *cotton* paper, is in the British Museum, dated 1049.

In the University of Germany a document is preserved, the paper of which is made of *linen rags*, dated A. D. 1170.

In 1200 mummy cloth was used by shop keepers in Egypt for wrapping paper.

The first paper mill was established at Nuremberg, Bavaria, in 1390, for manufacturing paper from linen and other rags.

The "water mark" first appeared on paper in 1498.

Henry VIII used, as his private mark on paper, a hog with a miter. He, having quarrelled with the Pope, wrote him a letter on paper having this mark, and, as the Pope considered it a personal insult, the quarrel never was settled.

Wall paper was substituted for tapestry in 1640.

Paper factories did not flourish in England until 1688, England imported her paper from Holland in 1663.

The first paper mill in the United States was established by William Rittenhouse, a Hollander, at Roxboro', near Philadelphia, in the year 1690. The raw material used was linen rags. The second in the United States was established at Germantown, near Philadelphia, in 1710.

In 1719 Reamer suggested that "paper might be manufactured from wood."

Paper is made from over 400 materials.

The rag engine was invented in Holland, about the middle of the seventeenth century, and superseded the hand mortar.

The first paper mill west of the Alleghany mountains was put in operation in 1796, near Brownsville, Pa., and was called the Red Stone Paper Mill.

In 1798 machinery was invented in France for making paper of large sizes, viz: 12 feet in width and 50 feet in length.

In 1801 Gamble obtained a patent for similar machinery.

The first steam paper mill in the United States was erected at Pittsburgh, Pa., in 1816.

In 1830, a sheet of paper 13,800 feet long and 4 feet wide, was made at White Hall, England.

Roberts and Gamble were among the first inventors of paper making machinery.

The use of wood pulp for manufacturing paper was first patented in 1854, and the first mill was established in 1865, at Manayunk, Pennsylvania. Poplar is principally used.

There are over 30 manufactories now in operation in England.

In 1770 there were 40 paper mills in the United States; in 1810, 185; in 1870, 669.

In 1880, there were 3,985 mills in the world, making 1,904,000,000 pounds of paper per year. Of this amount 600,000,000 pounds per year were used for newspapers.

As to the use of paper by individuals, an average of eleven and one-half pounds is used by an Englishman, ten and one-fourth pounds by an American, eight pounds by a German, seven and one-half pounds by a Frenchman, three and one-half pounds by an Italian or Austrian, one and one-half pounds by a Spaniard, one pound by a Russian, and two pounds by a Mexican.

PAPER MAKING.

692 Manufactories in the United States.

	1860	1880
Capital Invested,	$14,052,683.00	$46,241,202.00
Value of Productions,	21,216,802.00	55,109,914.00
Wages Paid,	2,767,212.00	8,525,355.00
Hands Employed,	10,911	24,422

1880

Printing Paper, tons,	149,177	Colored Paper, pounds,	14,756,268
Writing " "	32,937	Bank note " "	296,000
Wrapping " "	134,294	Tissue, " "	8,125,957
Binder's Board, "	20,014	All other " "	178,719,831
Wall Paper, "	14,737		

2,289 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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6

SOAP AND CANDLE MAKING.

SOAP AND CANDLE MAKING.

No. 1. Primitive Soap Making.

2. " Candle Making.

3. Manufacture Stearine—A. D. 1881.

4. Soap Boiling—A. D. 1882.

5. U. S. Patent, Decomposing Fats—A. D. 1882.

6. " " Soap Boiling—A. D. 1884.

In the Old Testament, mention is made of soap in Jeremiah ii, 22, and Malachi iii, 2. The Hebrew translated means the lye, salt potash and the salt soda. Lyes, or solutions of these salts, were used for the sake of their active detergent qualities, as we now use the soaps, before the method was discovered of softening down by causing them to combine with oils or grease.

The ancient Egyptians appear to have been unacquainted with soap. Pliny ascribes the invention to the Gauls. Through them the Romans learned the art of making it, but for a long time the material seems to have been valued more as a wash for the hair than for its general detergent applications.

The inhabitants of Pompeii possessed at least one complete soap-boiling establishment, which, when brought to view after having been buried more than seventeen hundred years, was found to contain soap in good preservation.

Soap manufacture is more largely carried on in Great Britain than in any other country, the annual product being estimated at over 200,000,000 pounds.

The manufacture is also carried on to a great extent in the United States, New York, Pennsylvania, Ohio and Illinois being the States in which the principal factories are located.

Pliny mentions that the Romans first made use of candles, which were little strings dipped in pitch or surrounded with wax.

Pliny also observes that wax candles were made use of for religious purposes, and those of tallow for common occasions.

Candles were introduced into churches A. D. 274. St. Jerome mentions the custom of lighting up candles at the reading of the Gospel, even at noonday, describing it as an emblem of joy, and of that light which the Psalmist says was "a lamp unto his feet and a light unto his path."

Eusebius, fourth century, states that the Emperor Constantine caused the whole city of Constantinople to be illuminated on Easter eve with lamps and wax candles.

The early Christians, driven by persecution into caves and catacombs, experienced the want of artificial light, and the first use of modern candles is referred to in their times.

It is probable that the Romans introduced candles into England. Alfred the Great used a graduated wax candle as a time keeper. In the middle ages wax candles were in use, some of them being of 50 pounds weight.

Splinters of wood, dipped with animal fat or oil, were used in England A. D. 1300. The pith of the swamp rush was subsequently used for a wick, and was called the rush light.

Candles were not in general use for domestic purposes until towards the close of the thirteenth century, when they were noticed as being made of tallow.

Stearine and paraffine are largely used in the manufacture of candles.

FATS.

SUB CLASS

SOAP AND CANDLES.

629 Manufactories in the United States.

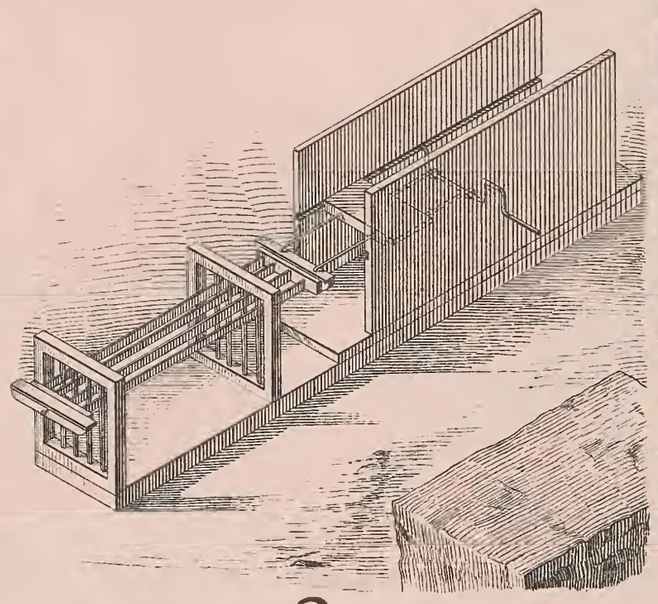
	1860	1880
Capital Invested, -	$6,347,138.00	$14,541,294.00
Value of Productions,	18,464,574.00	26,552,627.00
Wages Paid, - -	1,066,390.00	2,219,513.00
Hands Employed, - - -	3,247	5,289

309 Patents Granted by the United States.

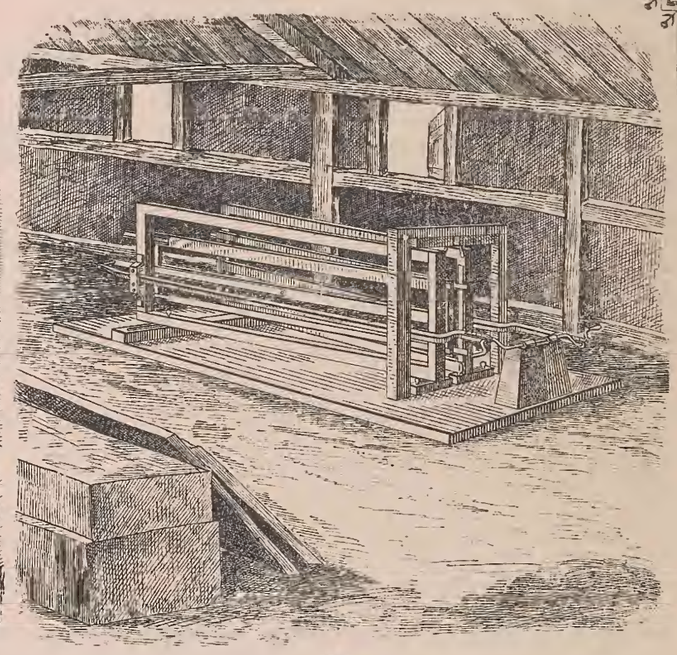
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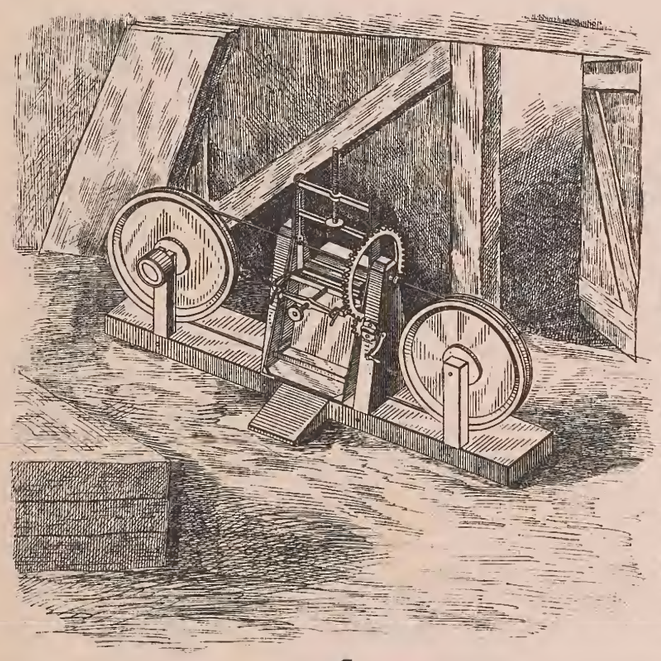
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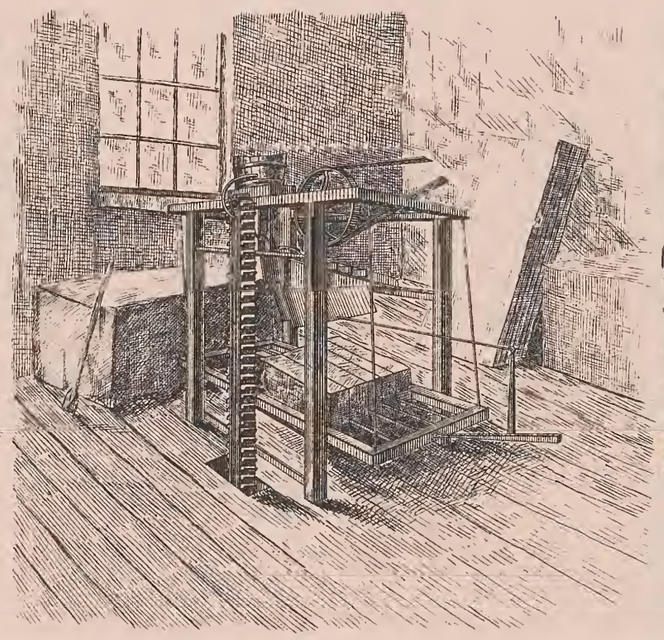
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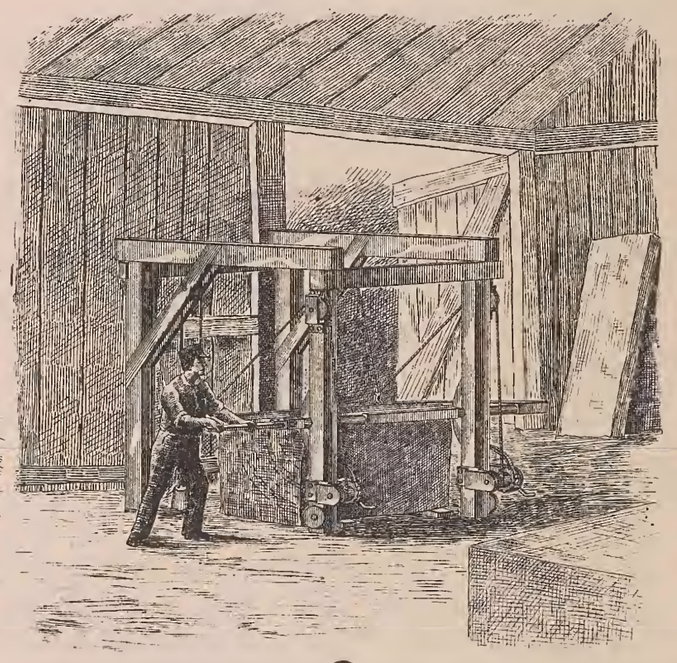
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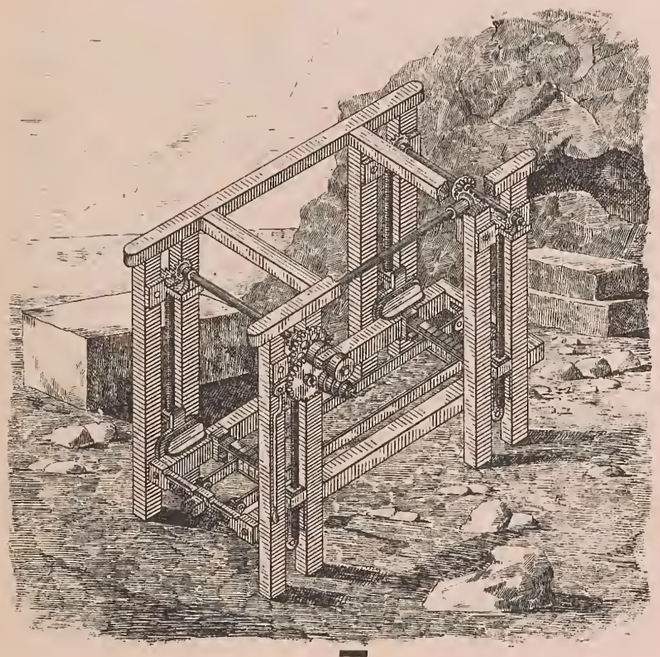
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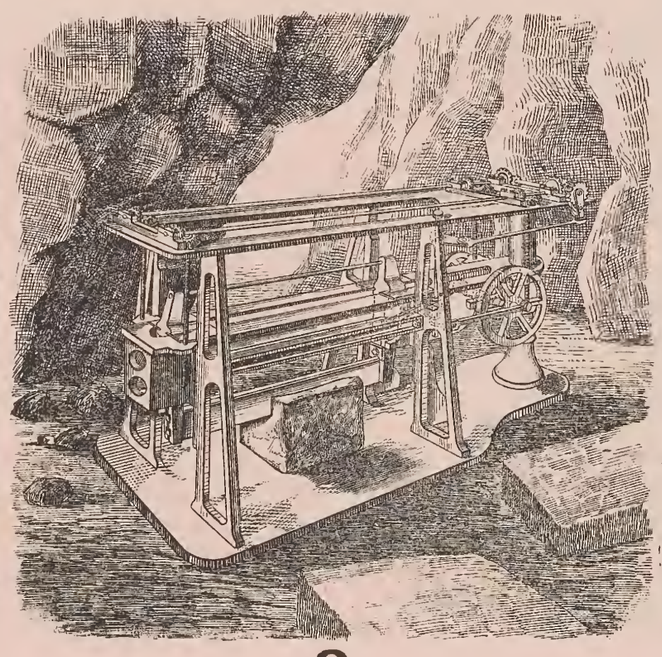
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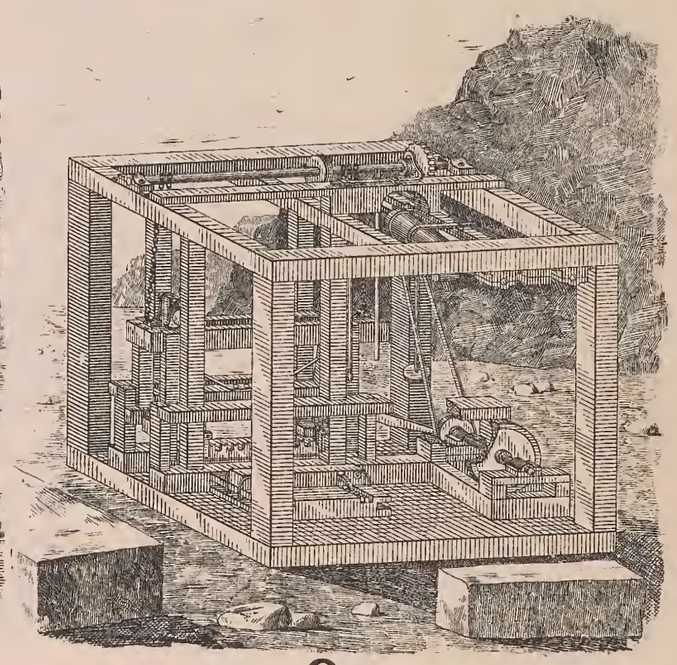
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9

STONE SAWING.

STONE SAWING.

No. 1. Primitive Stone Sawing.
2. U. S. Patent, Sawing Square Slabs—A. D. 1840.
3. " " Angular Sawing—A. D. 1855.
4. " " Sawing Moldings—A. D. 1858.
5. " " Sand and Water Feed Sawing—A. D. 1872.
6. " " Curved Sawing—A. D. 1872.
7. " " Screw Feed—A. D. 1876.
8. " " Automatic Feed—A. D. 1878.
9. " " Under Side Sawing—A. D. 1879.

The Phœnicians are entitled to the credit of the use of the stone saw.

Skilled mechanics erected Solomon's Temple of "stone sawed within and without."

Pliny gives an account of the different kinds of sand used for cutting stone, for "it is the sand, properly," he says, "and not the saw which produces the effect."

Clark states that all the cavities of the famous Parian quarries were cut with the greatest nicety, and shewed, by the sharpness of their edges, the number and size of the masses of marble which had been removed for the sculpture of Ancient Greece. He adds, that if the stone had possessed the softness of clay, and had been cut by wires, it could not have been separated with greater nicety, evenness and accuracy.

Choice varieties of marble were employed by the ancients, both in architecture and sculpture.

The celebrated Venus De Medici was cut from Parian marble.

The Parthenon, Hippodrome and other monuments of Athens were of Pentelic marble.

A marble called "Marmo Greco," or Greek white, was obtained from the Island of Scio, or Chio, the scene of the late earthquake.

There are columns and altars in Venice made from a transparent white marble called by the Italians "Marmo Statuario." The quarries from which this marble was obtained are now unknown.

The black marble of the Ancients is only to be found in specimens of sculpture, from which it may be inferred that the quarry from which it was obtained was exhausted.

The red marble of the Ancients is of a blood-red color, interspersed with white veins.

Besides these antique marbles may be mentioned the green antique, the yellow, grand antique, the purple antique, and many other varieties of colored marble.

Of the modern marbles, we have the black, and the black-and-white, found in Derbyshire; the variegated marbles of Devonshire, of a reddish, brownish or greyish color, veined with white and yellow; the green marble of Anglesea, the white marble of Scotland, the black-and-white marble of Kilkenny, and many other varieties obtained from various counties in the United Kingdom, added to which Italy, Corsica, France, Sicily, Genoa, etc., yield abundant marbles of great beauty and variety of color.

Oliver Evans, of Philadelphia, in 1803, had a double-acting high pressure engine at work grinding plaster and sawing stone. He had twelve saws in a heavy frame sawing marble at the rate of one hundred feet in twelve hours.

For cutting marble a saw is used, which consists of a long, flat piece of soft iron, fitted into a frame such as stonecutters use, while sand and water are continually applied during the operation. Very large slabs of marble are sometimes cut by machinery.

In polishing marble, the surface is first rendered smooth and flat by means of fine, sharp sand, and water, a rubber of iron being sometimes used for the purpose.

A finer sand is then applied in the same way, and a third rubbing is given with still finer sand. After washing the surface of the slab, emery powder of various degrees of fineness is employed, and this is generally worked over the surface by means of a leaden rubber. The final polishing is done with tripoli, (rotten stone,) or with jewellers' rouge, coarse linen cloths rolled up into a hard ball being used as rubbers.

STONE SAWING.

2,892 Manufactories of Marble and Stone Goods in the United States.

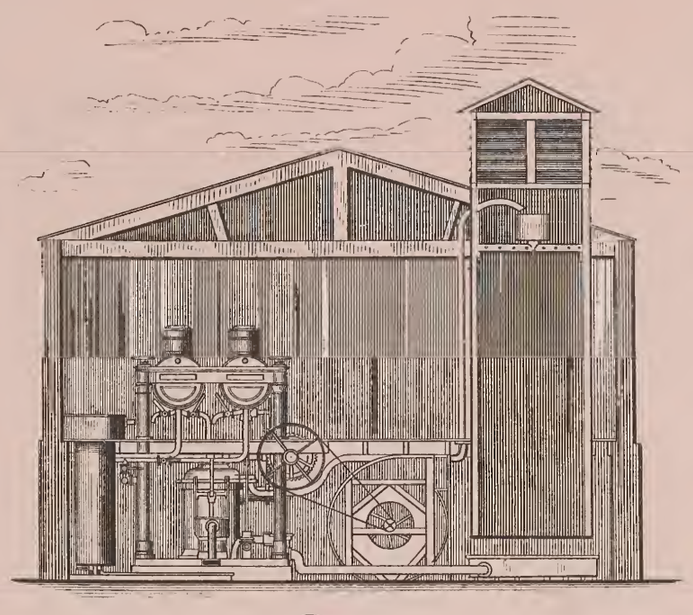
	1860	1880
Capital Invested,	$8,864,675.00	$17,248,521.00
Value of Productions,	16,244,044.00	32,445,810.00
Wages Paid,	5,672,211.00	10,551,894.00
Hands Employed,	15,379	22,196

128 Patents Granted by the United States.

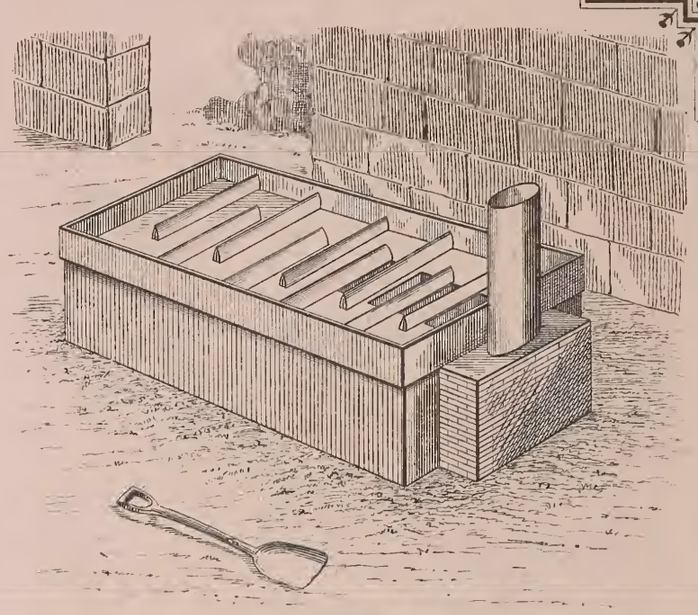
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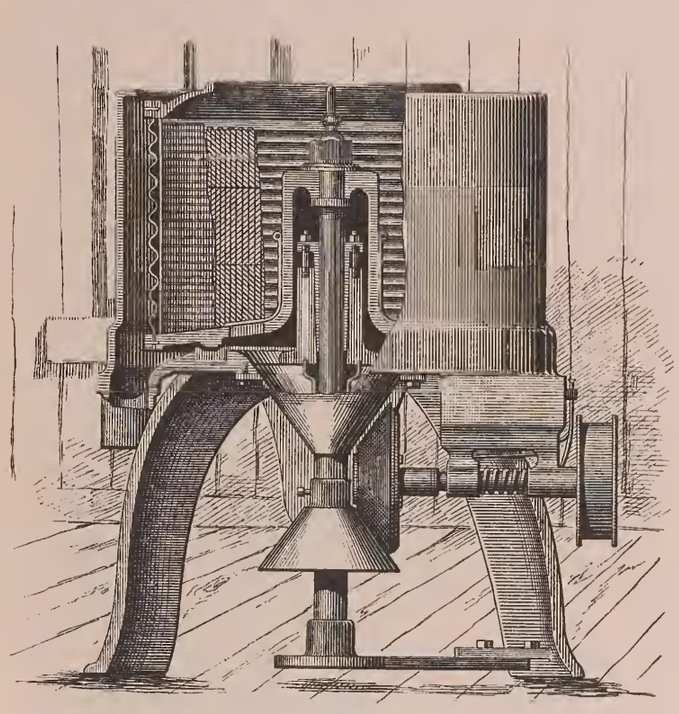
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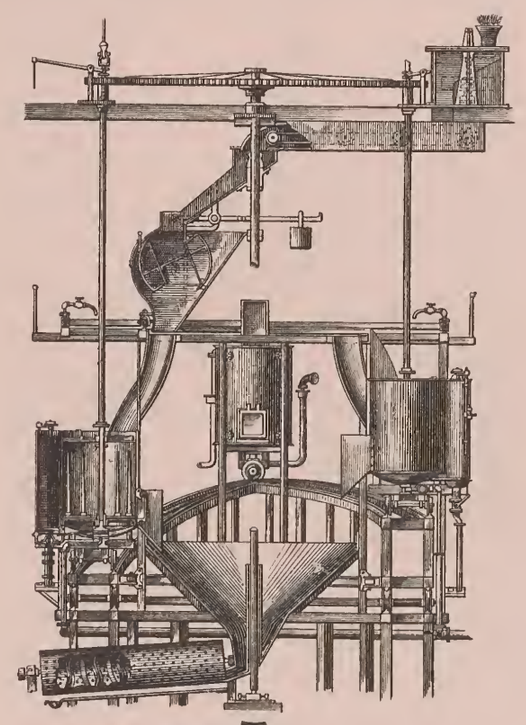
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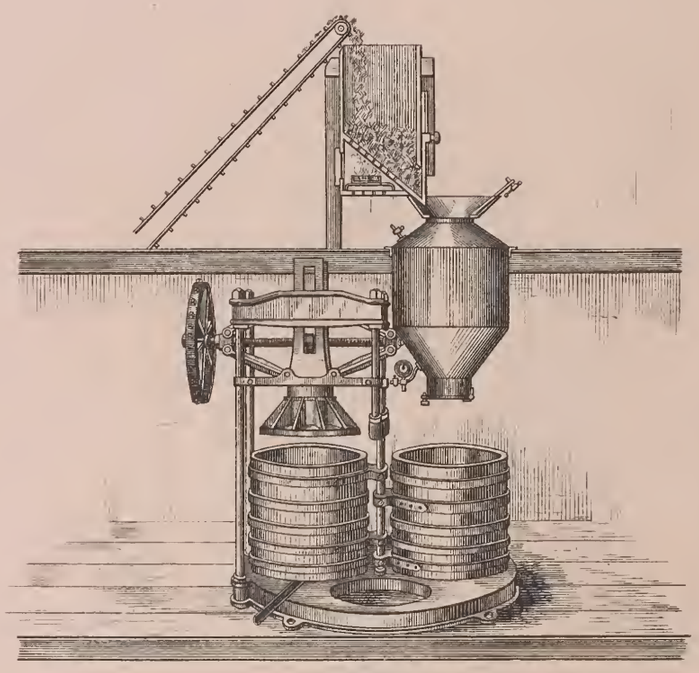
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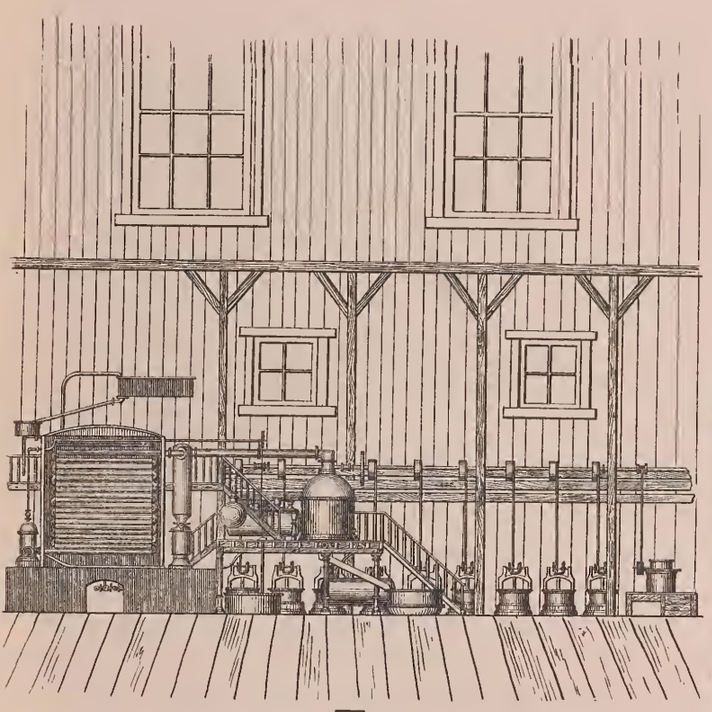
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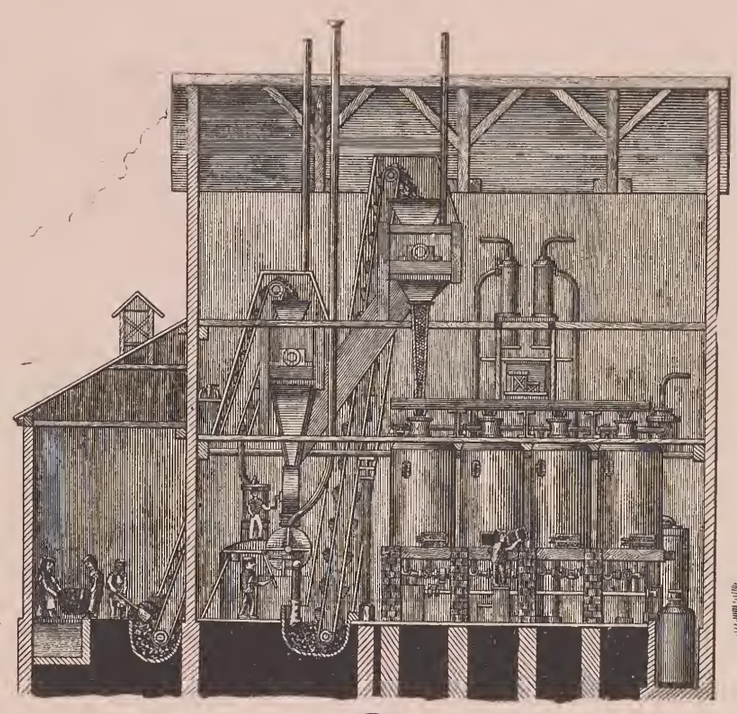
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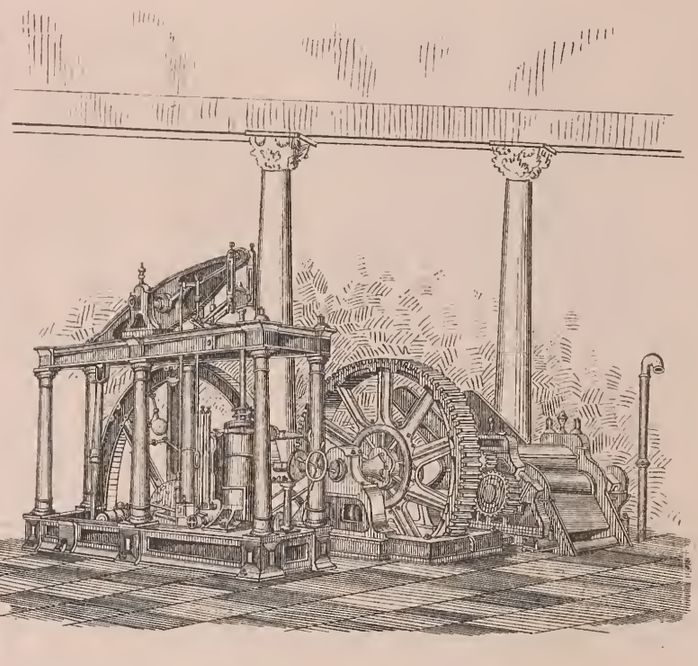
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9

SUGAR MAKING.

SUGAR MAKING.

No. 1. Primitive Maple Sugar Making.
2. U. S. Patent, Evaporating Pan—A. D. 1846.
3. " " " " —A. D. 1863.
4. " " Centrifugal Drier—A. D. 1874.
5. " " Extracting Cane Juice—A. D. 1876.
6. " " " " —A. D. 1884.
7. Cuban Vacuum Pans—A. D. 1876.
8. German Beet Sugar Machine—A. D. 1879.
9. Sugar Cane Mill—A. D. 1880.

It has been supposed that sugar cane was indigenous to America; this, however, is improbable, since it is not found growing wild in this or any other country. It probably originated in Bengal, where sugar was first manufactured.

Pliny noticed it as a curiosity of natural history, and Galen referred to it as "a kind of honey brought from Arabia and India."

It was known to the Greeks and Romans, but was not in general use among them.

The Chinese were acquainted with the manufacture of sugar two thousand years ago. Chinese sugar, in small quantities, occasionally found its way into Europe, and Greek physicians, who procured it from Arabian merchants, used it as a medicine.

Arabian navigators brought it from India.

Our term, sugar, is probably derived from the Bengalese "shukkur," the name by which it is still known in India.

The Arabs introduced it wherever they went; finally into Sicily and Spain. Through them it became known to the Crusaders.

It was not known in Europe prior to the thirteenth century.

From 1466 to 1580 sugar was rare in England, being procured from the Portugese. It was used only by the wealthy, or as medicine. Boiling and baking sugar were first practiced in Europe about 1420.

The Portugese took sugar cane to the Canary Islands, in 1506, and thence to the colonies on the coast of Africa and Brazil.

Refining sugar, and making it into loaves, were discovered by a Venetian in 1550.

Sugar is made from several plants and trees, notably from maple and beets.

Maple sugar was made by the North American Indians.

Making sugar from beets was first suggested by Oliver de Senes, in 1605.

Sugar was introduced into the Barbadoes from Brazil, in 1641.

It appears that the cane was planted in the West Indies some time before it was cultivated on a large scale for the manufacture of sugar. At first it was used only as an esculent vegetable, the stem being eaten in a raw state, after peeling, as is still the practice in China and some of the East Indian Islands.

In 1643 the English began to manufacture sugar at St. Christopher's, and in Jamaica in 1656.

The State of Connecticut granted a patent, in 1717, for making sugar from corn stalks.

The first successful beet sugar was made in 1747, by Inagraff.

The culture of sugar was introduced into Louisiana by the French refugees from St. Domingo.

The first successful attempt at sugar making in Louisiana was made in 1796, at Carrollton, near New Orleans.

Napoleon devoted 80,000 acres of land, and appropriated 1,000,000 francs to encourage sugar making from beets.

In 1803 there were eighty-one sugar estates on the Mississippi river.

Steam power for the manufacture of sugar was first introduced into Louisiana in 1822.

Sixty thousand tons of beet sugar are produced in France annually. Large quantities are also made in Northern and Central Europe, and the industry has been introduced into several of the Western States. About one-fourth of all the sugar in the markets of the world is made from beets.

The census for 1880 shows that the sugar crop of the United States was as follows; Cane sugar, 178,872 hhds.; cane molasses, 16,573,273 gallons; sorghum sugar, 12,792 pounds; sorghum molasses, 28,444,202 gallons; maple sugar, 36,576,061 pounds; maple molasses, 1,796,048 gallons.

SUGAR MAKING.

SUGAR AND MOLASSES.

	1880
Cane Sugar, hogsheads,	178,872
Molasses, gallons,	16,573,273
Sorghum Sugar, pounds,	12,792
Molasses, gallons,	28,444,202
Maple Sugar, pounds,	36,576,061
Molasses, gallons,	1,796,048

Capacity of Sugar Pans—diameter, 17 feet; height, 30 feet. 400 pounds dry Sugar each charge.

1,738 Patents Granted by the United States.

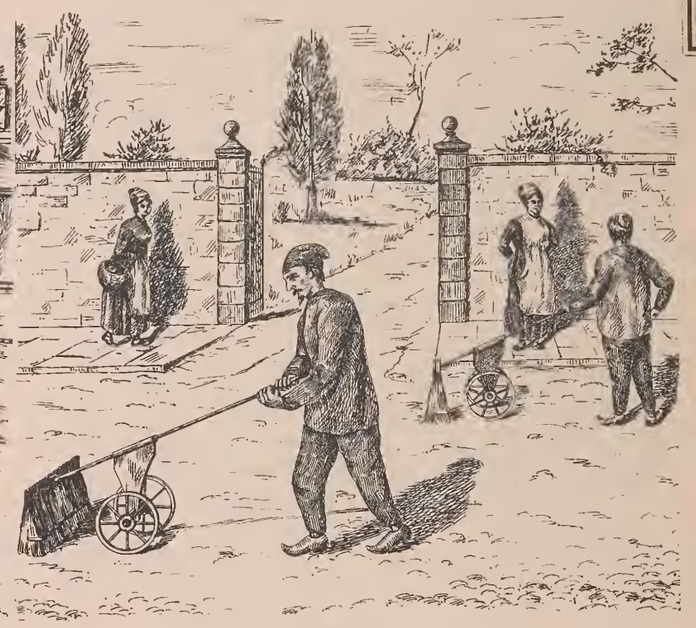
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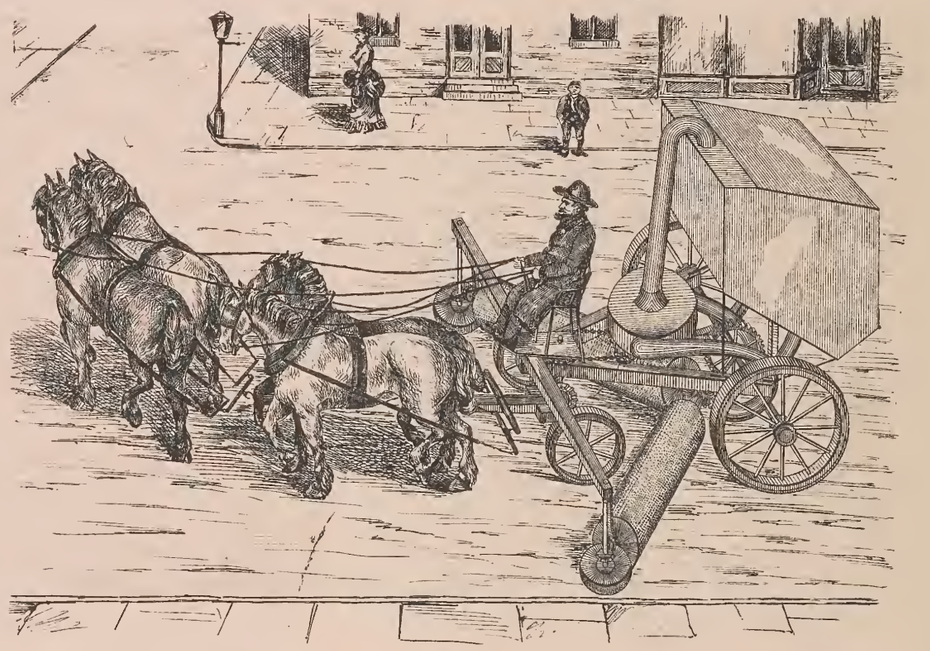
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SWEEPING.

SWEEPING.

No. 1. Primitive Hand Broom.
2. " " Street Sweeping.
3. French Street Sweeping—A. D. 1836.
4. U. S. Patent, Hand Broom—A. D. 1852.
5. " " " Sweeper—A. D. 1858.
6. " " " Broom—A. D. 1852.
7. " " " Sweeper—A. D. 1884.
8. " " Street Sweeper—A. D. 1884.

The word besom, meaning broom, is used by Isaiah in speaking of the destruction of Babylon, "I will sweep it with the besom of destruction."

Brooms having long sticks to them were used by the Romans; they had also bristle brushes.

In Paris, in 1285, an order was issued that each citizen should keep the street clean in front of his own house.

In 1750, Benjamin Atkman, of Bradford Co., Pa., commenced the manufacture of brooms from broom corn. A few years after he took B. Croasdale into partnership, and they jointly held the trade in brooms until 1816, supplying the markets of Philadelphia, Baltimore, Trenton and New York.

The street sweeping machines of Paris have a broom attached to the rear of a two-wheeled vehicle by means of a frame work, which is so hinged to the axle of the vehicle as to enable the conductor on the box in front to raise it out of contact with the pavement or to depress it for service at pleasure.

Nearly all the bristles used in making brushes in the United States are imported from Russia. They come assorted as to length and stiffness.

The improvement in breeding the American hog has nearly deprived him of usefulness as a bristle producer.

Horse hair, Tampico grass and steel and brass are also extensively used in the manufacture of brooms.

There are brooms in England called heath brooms, which are made of a small shrub growing on the sandy heaths of Great Britain. A similar shrub is found in great abundance in Spain, and is doubtless the same which Pliny speaks of as covering the mountains near Carthagena. This shrub is called "broom," and is supposed to have given the name to implements for sweeping.

The material of which brooms are generally made is a kind of Sorghum called broom corn, which is extensively cultivated in Europe and America.

Very simple machinery is used in the manufacture of brooms, consisting of a wooden roller, turned by a crank for the purpose of winding on the cord. One hand holds the broom handle, and, while winding on the twine, the brush is supplied with the other. The machine has also a bench and a rag wheel to hold the cord when wound on the roller.

The societies of Shakers in the United States are largely engaged in making brooms.

SWEEPING.

Capacity—Street Sweepers.	Primitive Mode.	Present Machine.
Miles per day,	1	15
Hands Employed per day,	1	1

123 Patents Granted by the United States.

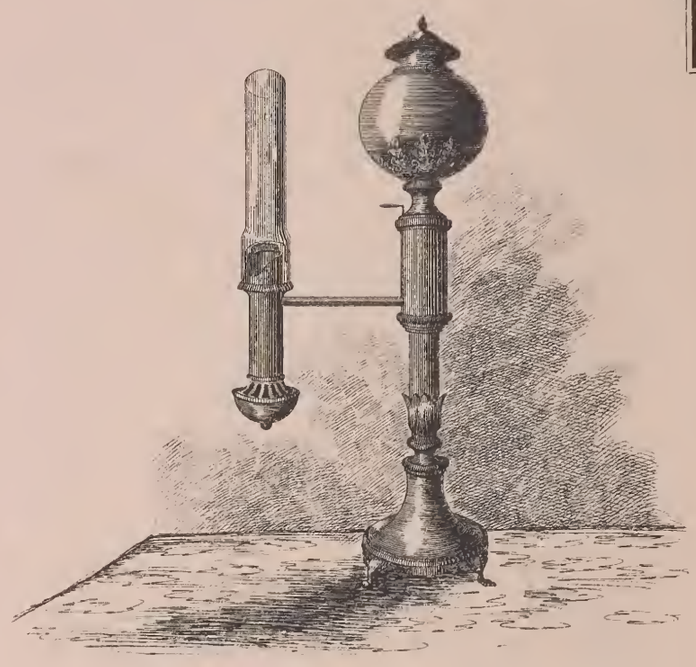
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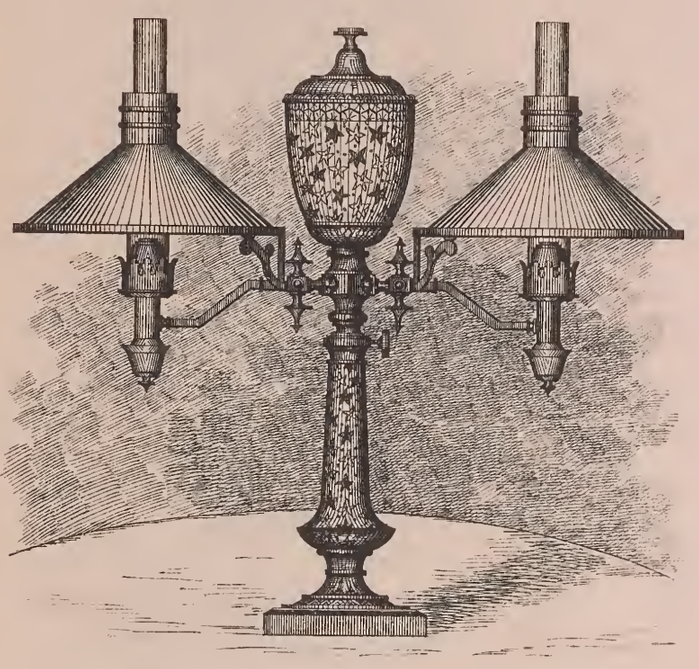
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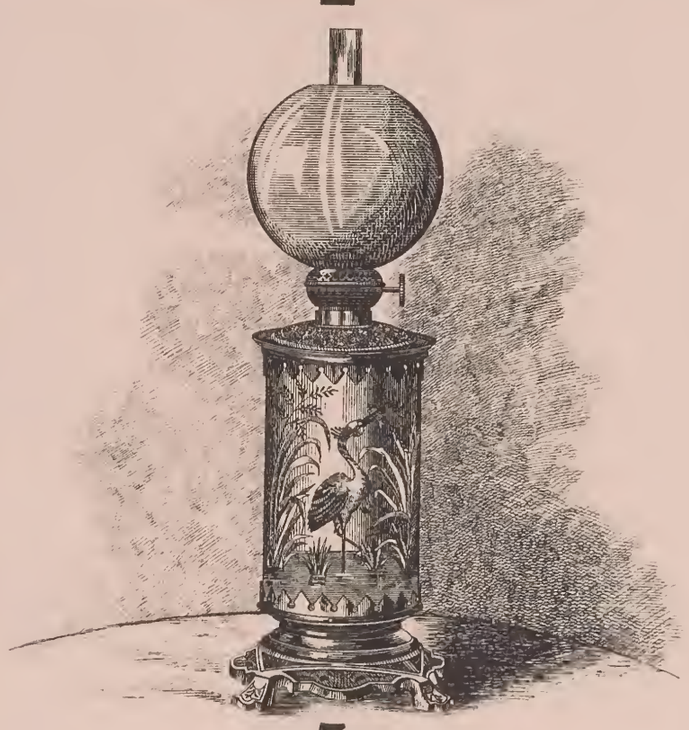
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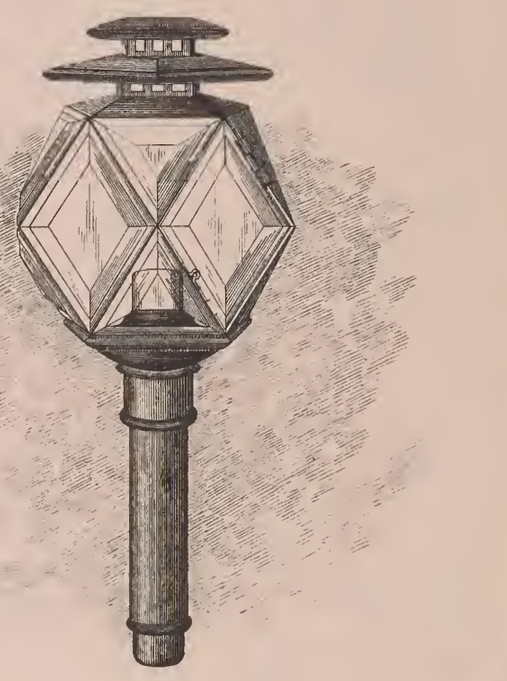
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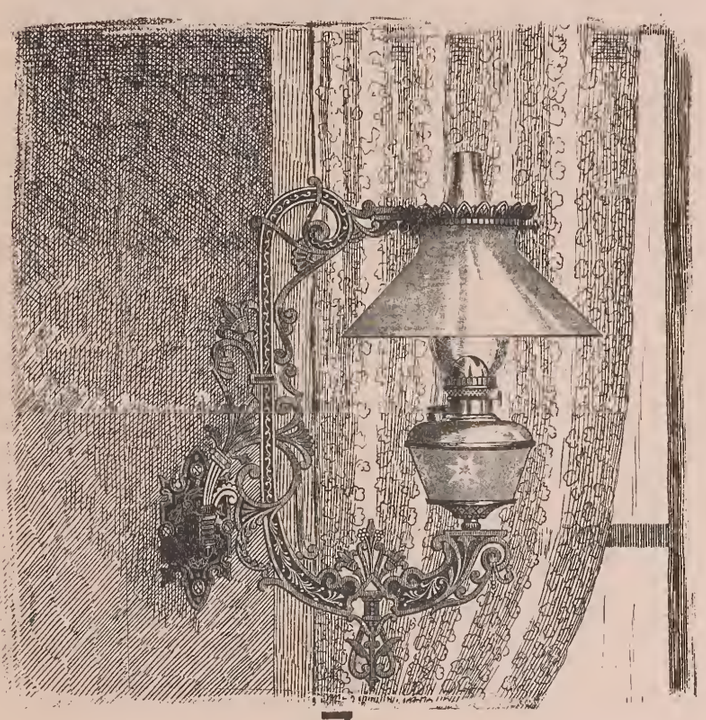
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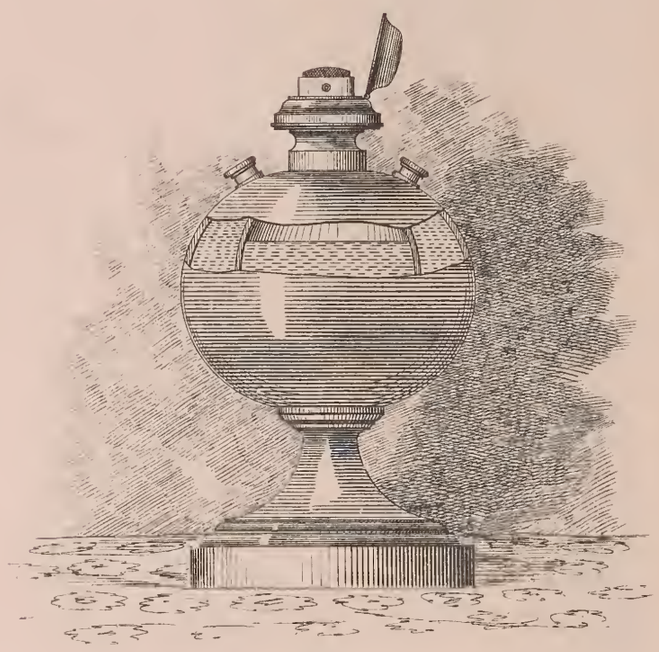
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9

STAND AND BRACKET LAMPS.

STAND AND BRACKET LAMPS.

No. 1. Primitive Greek and Roman.
2. " Floating Light.
3. " Argand—A. D. 1784.
4. " Student Lamp.
5. " Stand Lamp.
6. U. S. Patent, Carriage Lamp—A. D. 1865.
7. " " Bracket Lamp—A. D. 1874.
8. " " Automatic Cigar Lighting Lamp—A. D. 1879
9. " " Safety Lamp—A. D. 1882.

The most primitive lamps were probably the skulls of animals, or certain sea shells, in which fat was burned.

Lamps were used in the early ages in China, India, Egypt, Greece and Rome, and preceded the use of candles.

Many beautiful forms of lamps have been taken from the excavations of Pompeii.

The Egyptians first used lamps in their temples.

Green porcelain lamps were found in the great pyramids of Ghizeh, and were also used in the tabernacle and the temples of the Jews.

The festival of Isis at Busirius was called "the feast of lamps." The lamps had wicks floating in oil which rested on salt water.

Hero wrote a description of a lamp, 150 B. C., in which a supply of oil from a reservoir below is driven up by means of air introduced into the base by an air pump. In another form the oil was raised by water introduced below the oil by means of a pipe.

The Argand lamp, which was introduced in 1786, was so named from its inventor, a native of Switzerland.

L. Augi, a Frenchman, invented the lamp chimney; he added it to the tubular neck and central air tube of Argand's lamp, and perfected the invention.

The introduction of the Argand lamp produced a revolution in the manufacture of lamps, but threatened with ruin all those whom the patent excluded from participating in the new trade, to such an extent that Argand was publicly persecuted by the tinners and iron mongers who disputed his rights to infringe the profits of their chartered vocation.

The streets of Boston, Mass., were lighted for the first time with lamps in 1774.

Sir Humphrey Davy invented, in 1815, the fine wire safety lamp, for preventing explosions by fire-damp in mines.

Lamps of present date are designated for purposes used, as bracket, car, cigar lighting, miners' and street; and form of construction, as forced draft, independent reservoir, safety tube, and central draft.

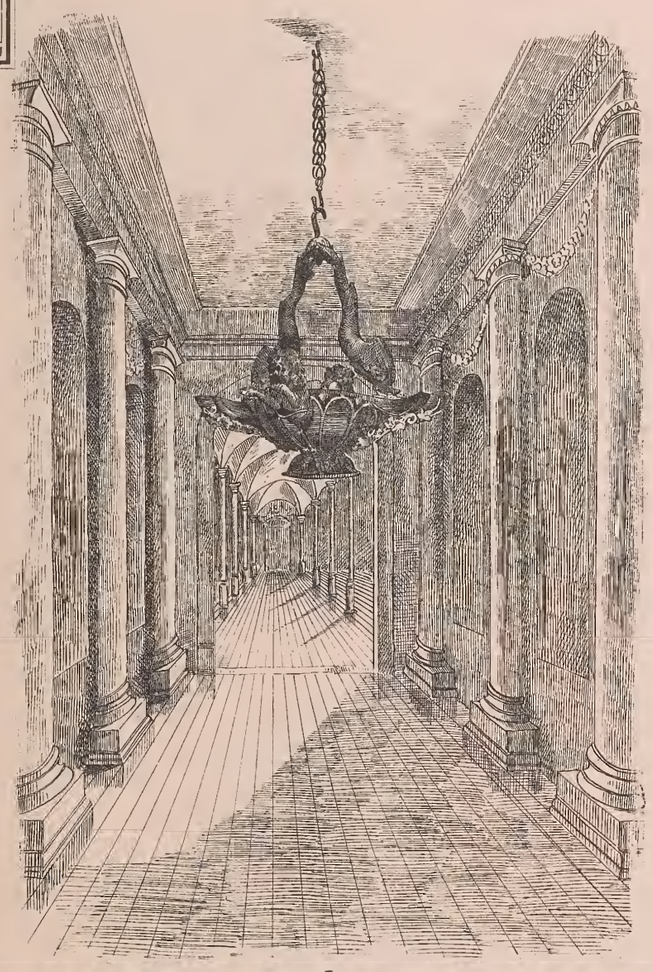
STAND AND BRACKET LAMPS.

74 Manufactories of Lamps and Lanterns in the United States.

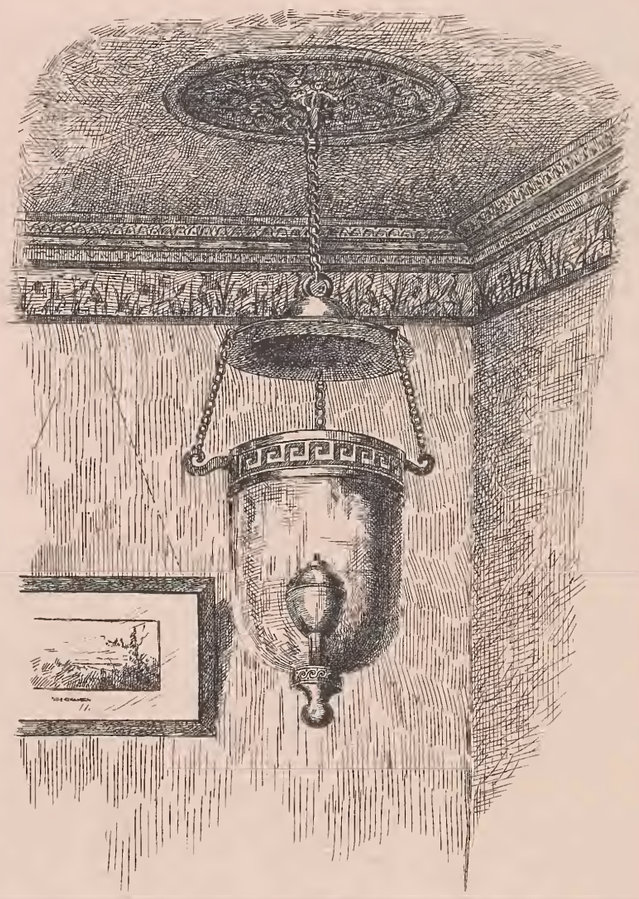
	1860	1880
Capital Invested,	$235,800.00	$1,873,625.00
Value of Productions,	578,020.00	3,357,829.00
Wages Paid,	135,848.00	742,423.00
Hands Employed,	374	1,730

4,816 Patents Granted by the United States.

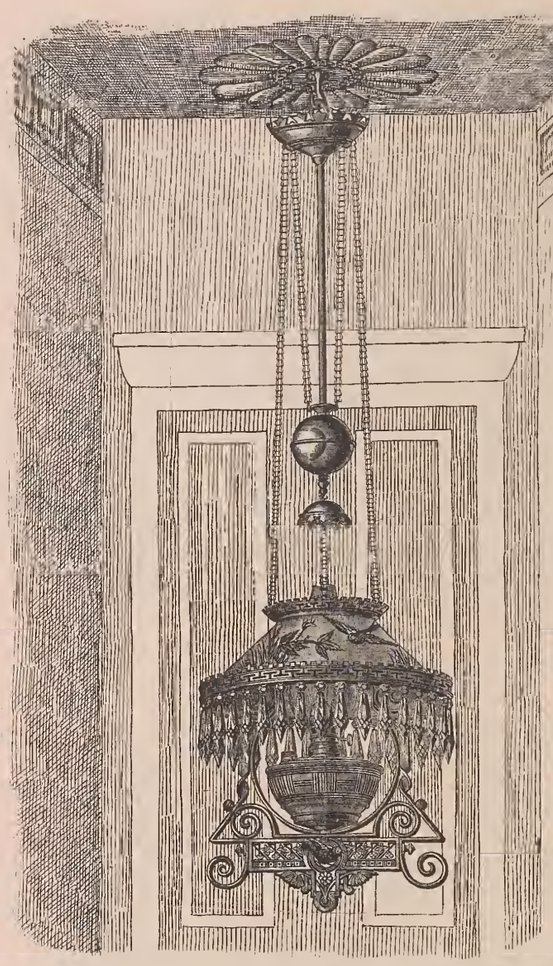
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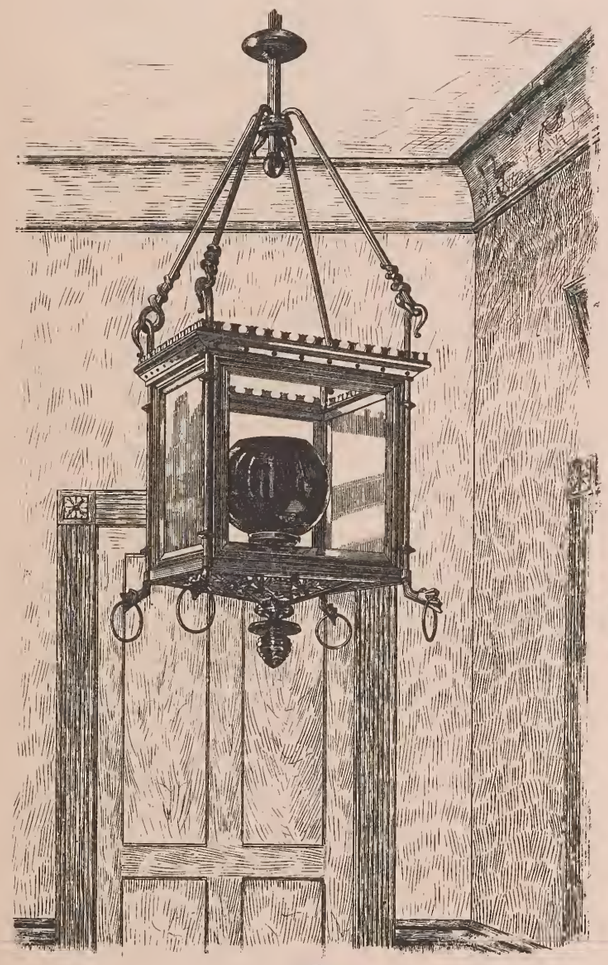
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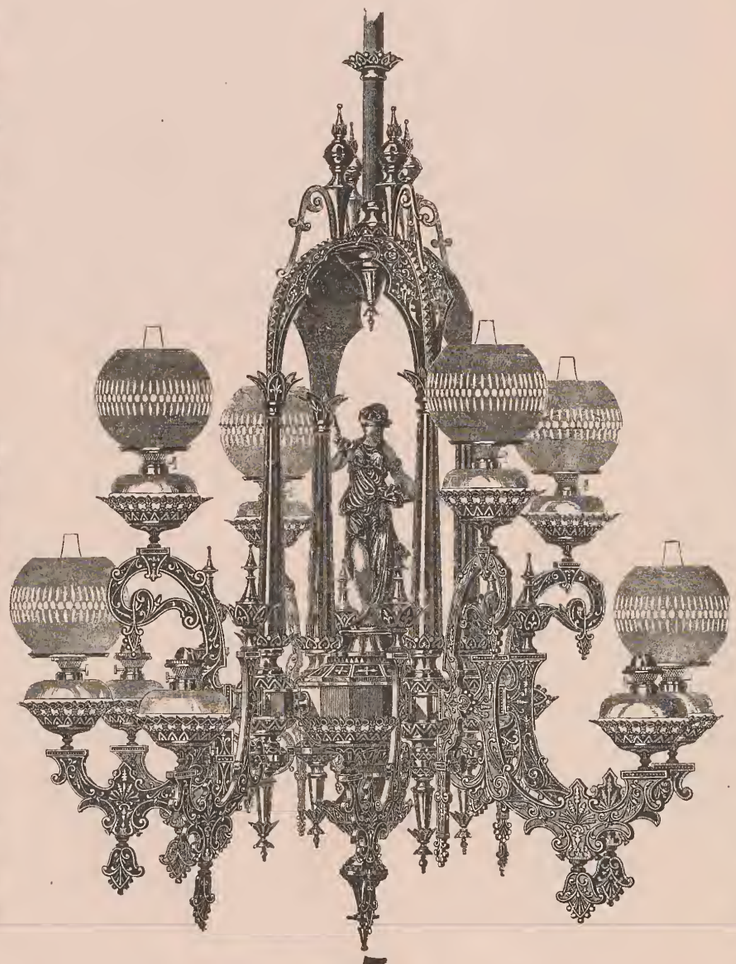
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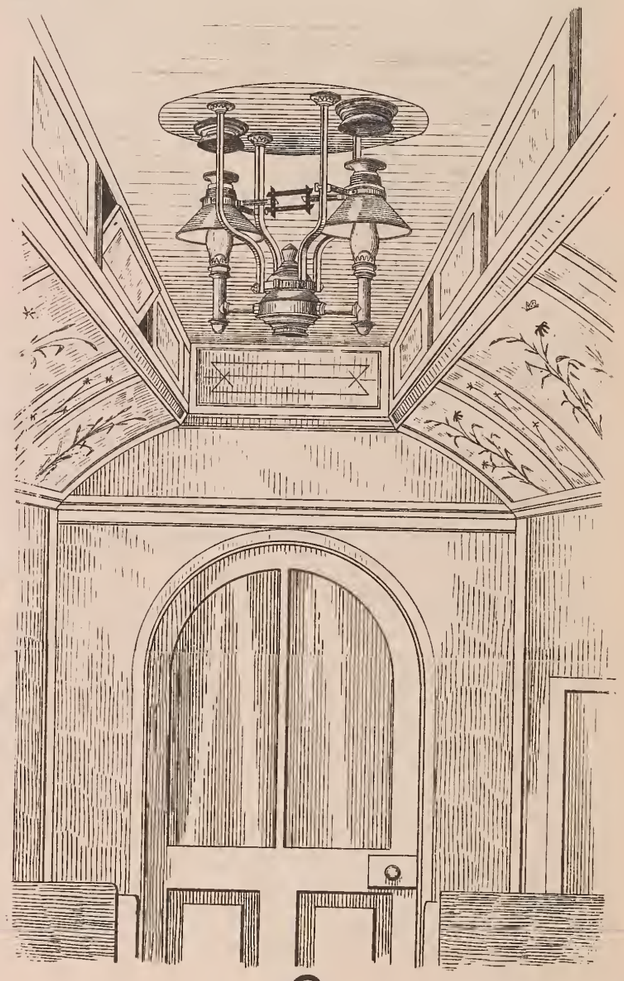
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SUSPENDED LAMPS.

SUSPENDED LAMPS.

No. 1. Primitive Roman Chandelier.

2. " Hall Lamp.

3. U. S. Patent, Suspended Lamp—A. D. 1875.

4. " " " " —A. D. 1875.

5. " " " Chandelier—A. D. 1875.

6. " " Car Lamp—A. D. 1883.

It was customary among the Romans to have a lamp hanging from the ceiling. It was also the custom on occasions of national rejoicing to have public illuminations, when lamps were suspended at the windows of houses.

The streets of Antioch, according to St. Jerome, were provided with lamps.

In 1697 the streets of New York City were ordered "to be lighted." The lighting was to be done by a lantern suspended from a pole stretched out from the window of every seventh house.

An act of Parliament in 1736 was passed for the regular lighting of the streets of London, and an estimate was made of the expense of introducing small globular lamps. It was calculated that 4,300 would be required.

In 1783 the lighting of the streets of Baltimore, and a day police, were established by the town authorities. The essential parts of a lamp are a vessel containing liquid fat, from which a portion rises gradually by capillary attraction through the wick to the flame.

The introduction of mineral oils, known under the various names of paraffine, petroleum, kerosene, naphtha, &c., has, in a great measure, superseded the use of animal and vegetable oils for lighting purposes.

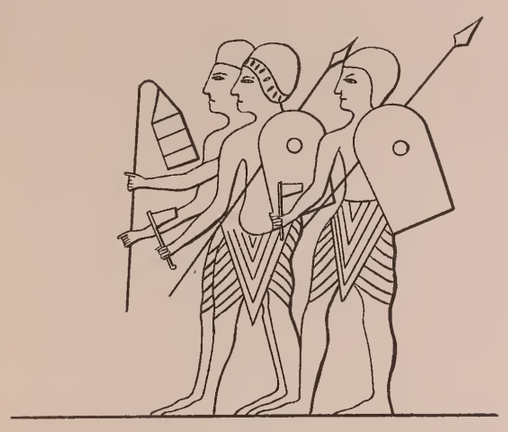
SUSPENDED LAMPS.

74 Manufactories of Lamps and Lanterns in the United States.

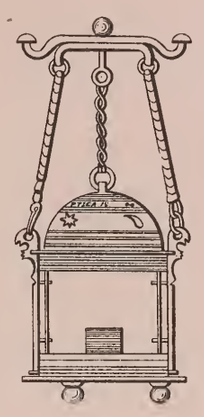
	1860	1880
Capital Invested, -	$235,800.00	$1,873,625.00
Value of Productions, -	578,020.00	3,357,829.00
Wages Paid, - -	135,848.00	742,423.00
Hands Employed, - - -	374	1,730

4,816 Patents Granted by the United States.

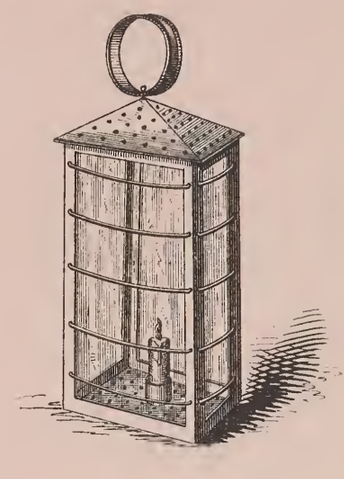
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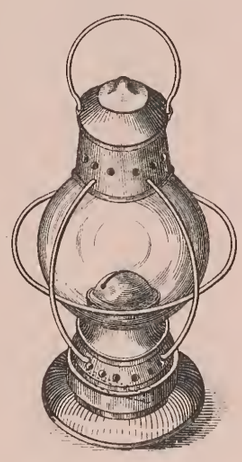
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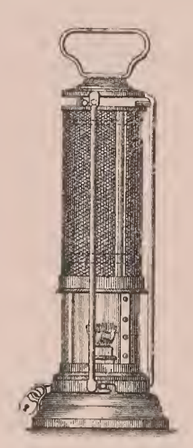
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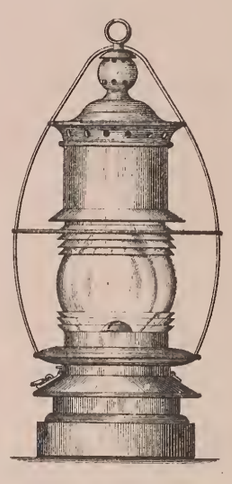
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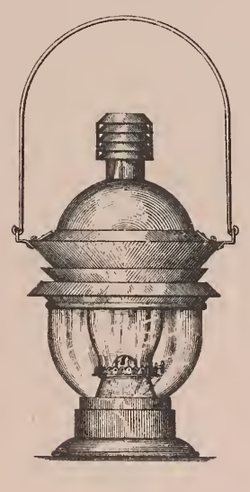
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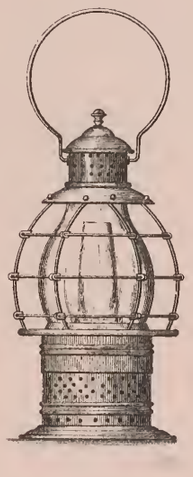
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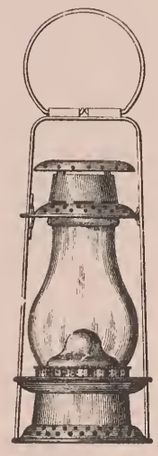
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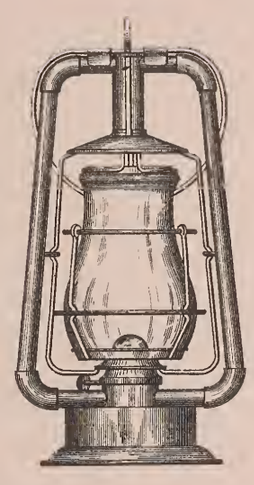
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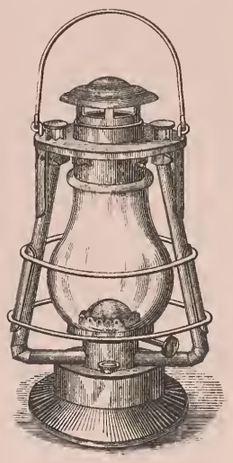
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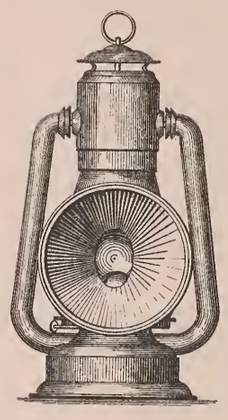
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15

LANTERNS.

LANTERNS.

No. 1. Primitive Egyptian.
2. " Roman.
3. " Square.
4. " Globe.
5. " Miner's Safety.
6. U. S. Patent, Globe—A. D. 1884.
7. " " Miner's Safety—A. D. 1878.
8. " " Globe—A. D. 1878.
9. " " " —A. D. 1878.
10. " " Signal—A. D. 1879.
11. " " Globe—A. D. 1880.
12. " " Naphtha Gas—A. D. 1881.
13. " " Tubular—A. D. 1883.
14. " " " —A. D. 1883.
15. " " Reflecting Globe—A. D. 1884.

Perhaps the original lantern is to be found in some varieties of fire flies in which the phosphorescent light (like Alfred's lantern, A. D. 890,) is protected by a horny covering.

The earliest example of a lantern is in sculpture at Alabastron, representing a patrol of soldiers armed with spears, shields and battle axes, preceded by one carrying a lantern a little in advance; the panels were probably of talc, the lapis specularius of the Romans.

The Egyptian lantern consisted of a waxed cloth strained over a cylinder of wire rings, with top and bottom of perforated copper.

Lanterns are referred to by Greek authors. Alexis said "The man who first invented the idea of walking out at night was very careful not to get his fingers burnt." Lanterns have been disinterred at Herculaneum and Pompeii. In the latter place one was found in the vestibule of a house beside a skeleton; the person was probably trying to escape in the thick darkness of the descending ashes.

The Roman lantern was made of bronze, with panes of bladder, horn, mica, parchment, and oiled silk.

The horn lantern of Alfred the Great had a graduated candle, which was his time measure.

Lanterns were used to some extent in London as early as 1417. It is recorded that "Lanthorns with lights bee hanged out on winter evenings betwixt Hallowtide and Candlemas."

The Abbe, Laudati, in 1662, obtained the exclusive privilege of letting out portable lanterns in Paris.

During the sixteenth, seventeenth and eighteenth centuries various European cities adopted the practice of lighting the streets by fixed lanterns.

The Chinese have a festival called "the Feast of Lanterns," in which they make an extraordinary display of the greatest variety, some being of enormous size, sometimes twenty-five and thirty feet in diameter.

Lanterns for lighting streets have been superseded by gas and electric lights.

The use of lanterns is now restricted to hand, ships, mining, etc., where the introduction of pipes is not attainable.

LANTERNS.

74 Manufactories in the United States.

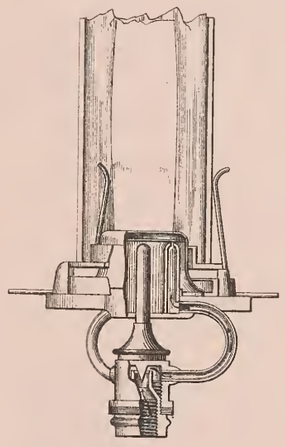
	1860	1880
Capital Invested,	$235,800.00	$1,873,625.00
Value of Productions,	578,020.00	3,357,829.00
Wages Paid,	135,848.00	742,423.00
Hands Employed,	374	1,730

615 Patents Granted by the United States.

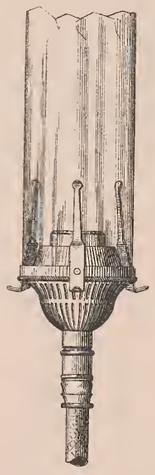
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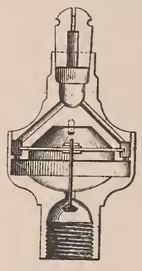
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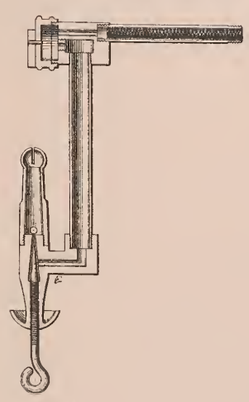
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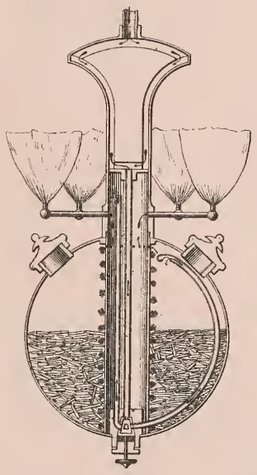
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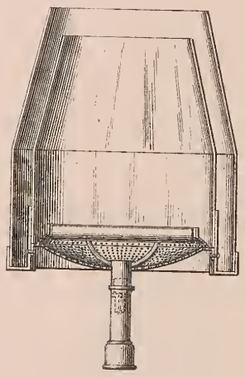
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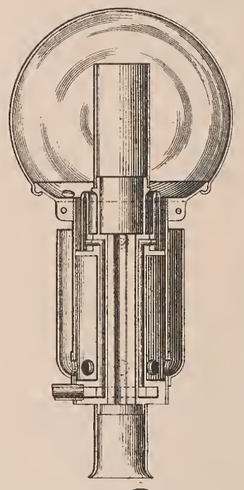
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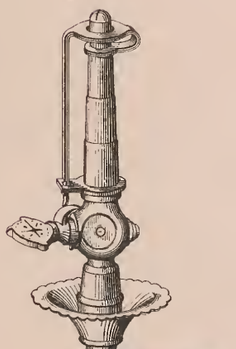
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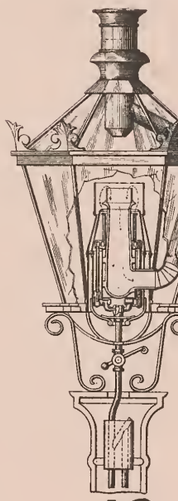
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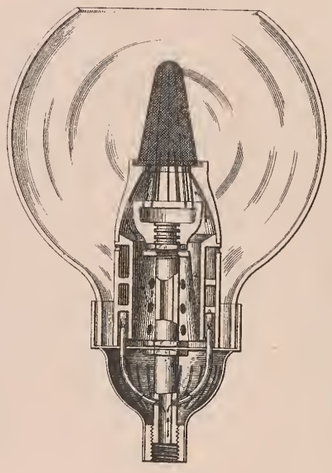
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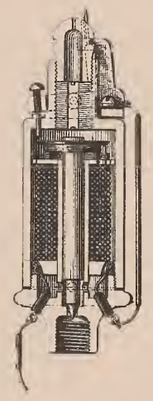
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GAS BURNERS.

GAS BURNERS.

No. 1. Bat Wing.
2 Argand.
3. U. S. Patent, Argand—A. D. 1868.
4. " " Self Regulating—A. D. 1875.
5. " " Vapor—A. D. 1878.
6. " " Enriching Attachment—A. D. 1881.
7. " " Flat Flame—A. D. 1883.
8. " " Heating Attachment—A. D. 1883.
9. " " Automatic Cut-off—A. D. 1883.
10. " " Regenerative Chamber—A. D. 1883.
11. " " Illuminating Burner—A. D. 1884.
12. " " Electric Lighting—A. D. 1884.

Dr. Clayton, in 1688, discovered that the air which comes from bituminous coal, when subjected to red heat in a retort, is inflammable and burns with a bright flame.

There is an account, published in 1733, of the carbonated hydrogen issuing from a coal work in Cumberland, England, having been collected in a bladder and made use of for the purpose of illumination, the gas being ignited at the extremity of a small tube attached to the bladder.

Mr. William Murdock, of Soho, England, in 1792, was the first person who put in practice the idea of producing light on an extensive scale by means of gas, and in 1798 applied it for the lighting of the very extensive manufactory of Messrs. Boulton, Watt & Co., at Soho, near Birmingham.

The illumination of the Soho Works by gas, in 1802, seems to have brought it into general notice.

In 1806 a Company was established for the purpose of conveying gas by means of pipes along the streets of London, so that they, as well as the houses, might be regularly supplied with it.

The first gas burner was called the cock spur jet, next the fish tail next the bat wing, then the iron Argand, the Albert shadowless, and the improved Argand. They are now classified under the following heads: Argand, anti-extinguishing, compound, hydro oxygen, hydro carbon, incandescent, illuminating, laboratory, multiple, oxy-hydrogen, regenerative, revolving, &c.

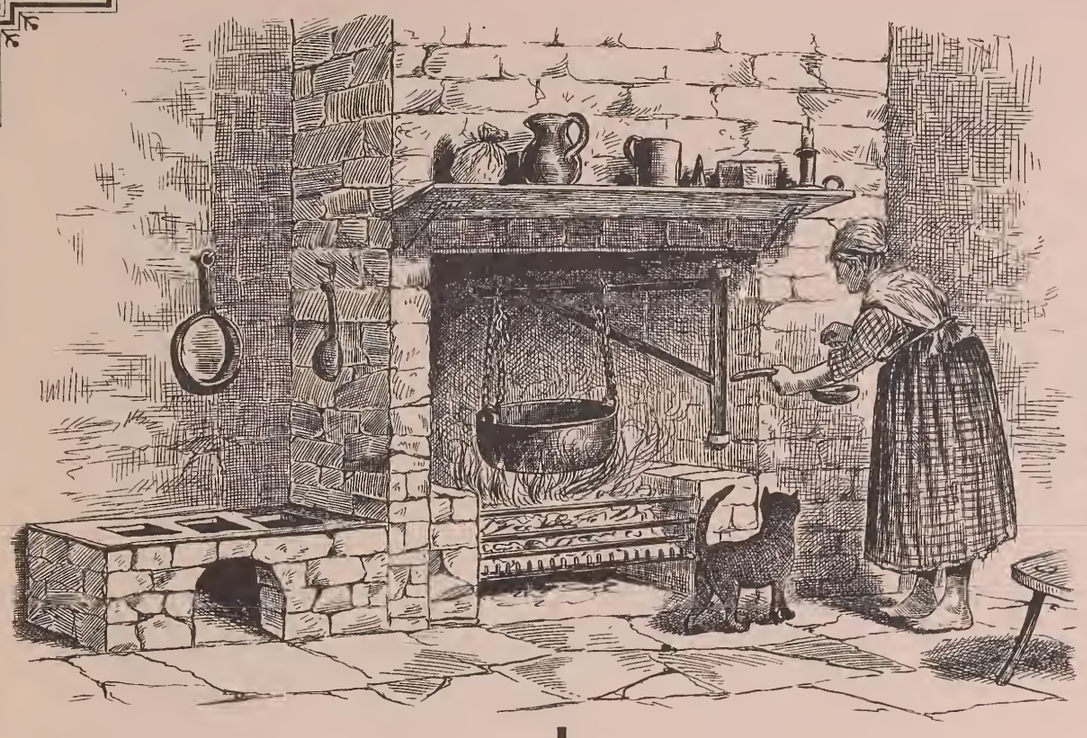
GAS BURNERS.

35 Manufactories in the United States.

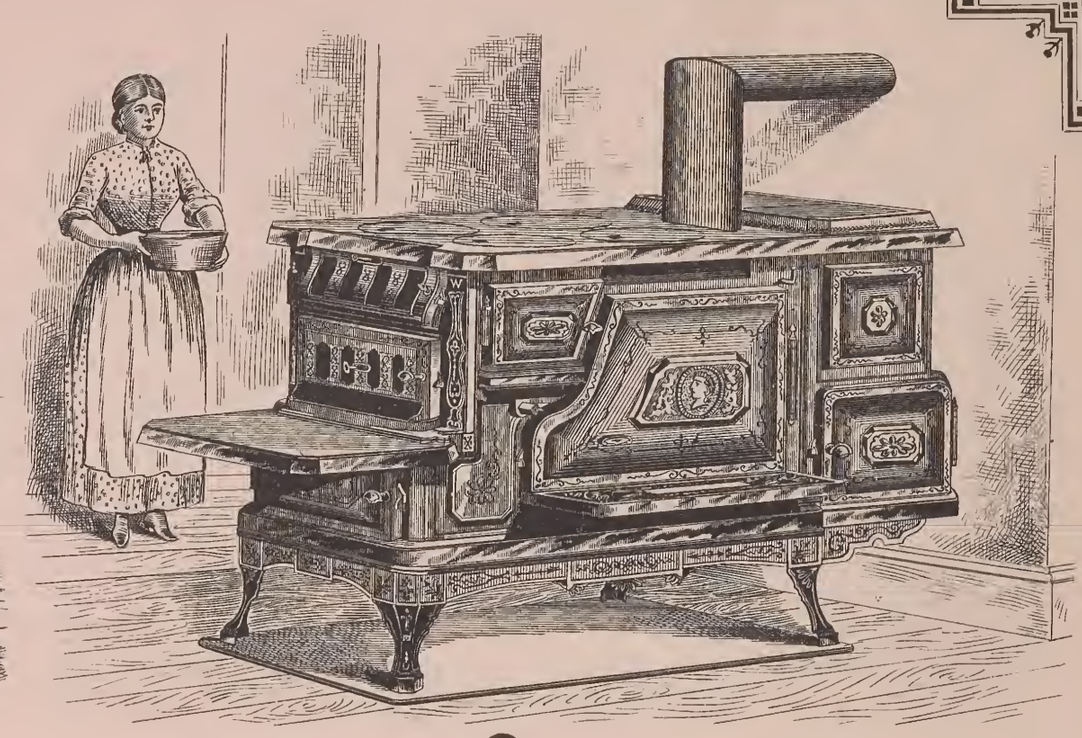
	1860	1880
Capital Invested, -	$1,310,850.00	$3,248,400.00
Value of Productions, -	2,255,900.00	4,329,656.00
Wages Paid, - - -	570,804.00	1,469,287.00
Hands Employed, - -	1,632	3,069

215 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



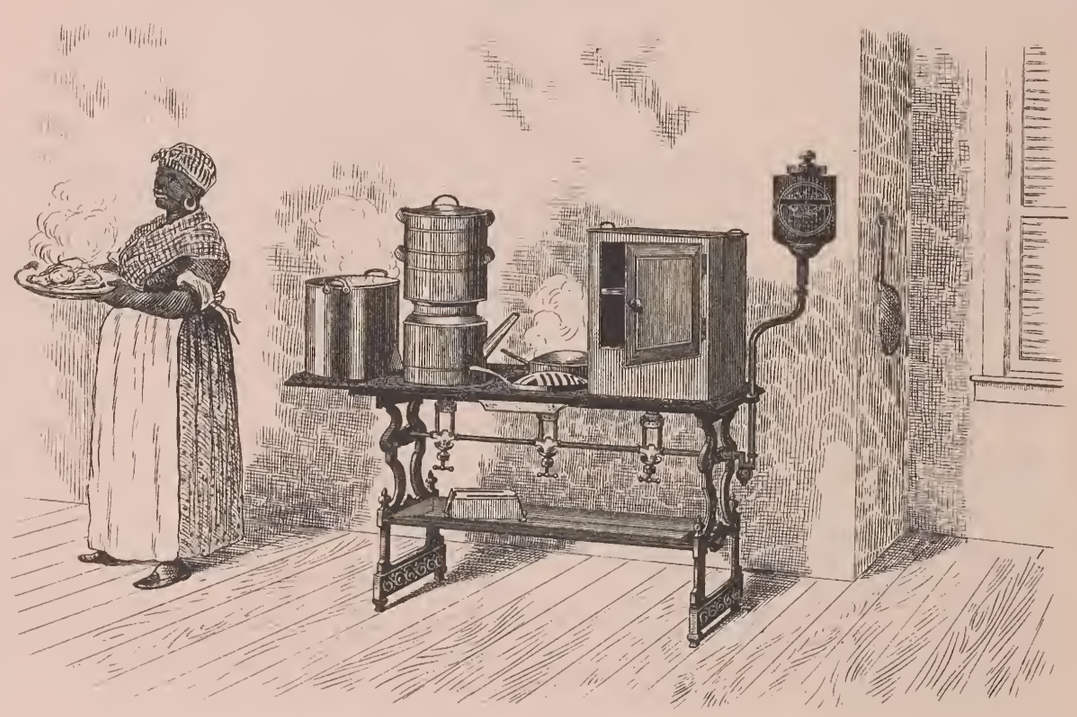
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COOKING STOVES.

COOKING STOVES.

No. 1. Primitive Cooking

2. U. S. Patent [illegible] Reservoir and Warming Oven—A.D. 1875.

3. " [illegible]—A. D. 1875.

4. " [illegible] Stove—A. D. 1878.

5. " [illegible] 1878.

6. " " [illegible] D. 1880.

A primitive mode of cooking in use among the savage tribes of New Zealand is called "stone boiling." A hole is dug in the earth, dry wood placed in it, and on that a number of stones; when the stones become red hot the unconsumed fuel is removed, wet green leaves are placed upon the stones, and upon the leaves the food to be cooked, more leaves over the food, and a mat over them all. Water is poured on the mat, and, finally, earth is added as an outside coating; and thus the food is cooked by a combined baking and steaming process.

The North American Indians use stones which have been made red hot in the fire, and put them, one after the other, into a vessel of water containing the food to be cooked.

The Jews were probably the first nation who had any regularly constructed ovens; in which they were followed by the Romans, who erected bake houses for the supply of food for their military.

One of the first attempts at constructing a stove, or closed fire place, was made by Polignac in 1709.

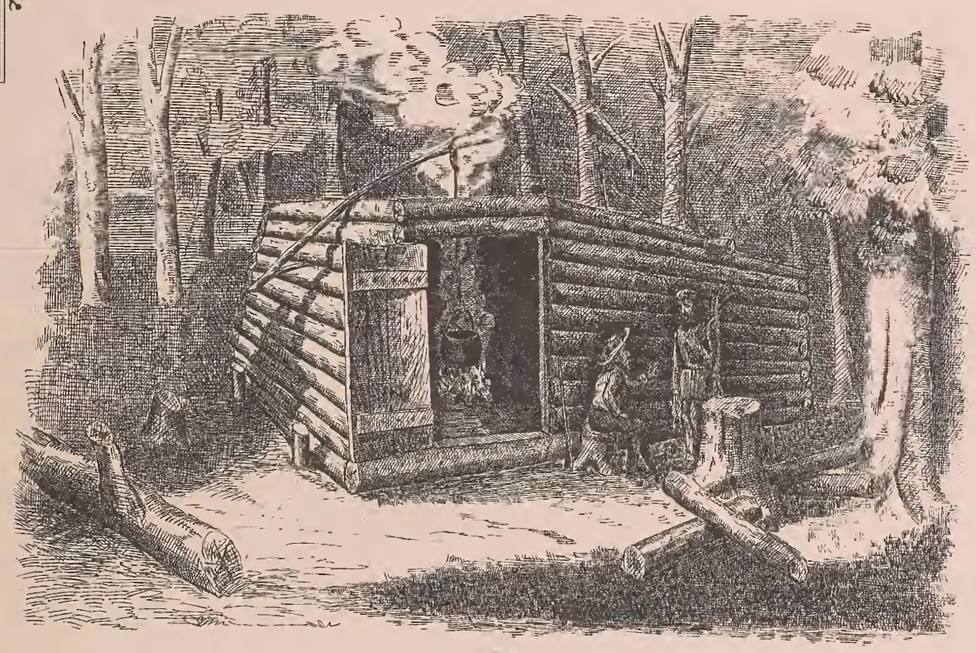
Count Rumford invented a cooking range in 1798; it was lined with brick and soapstone, with ventilating ovens.

The early patterns of cooking stoves were the ten plate oval, with the oven above the fire; the saddle bag pattern came next, the oven being in the middle over the fire; then the horse-block stove, the rear part being a step higher than the front. A rotary was also made, with a movable top to bring any particular vessel directly over the fire. Then came the parent of the modern cook stove, the Buck, for wood and coal, with the fire above the oven, which carried the flame around, behind and below the oven, the opening into the stove pipe being about on a level with the oven floor.

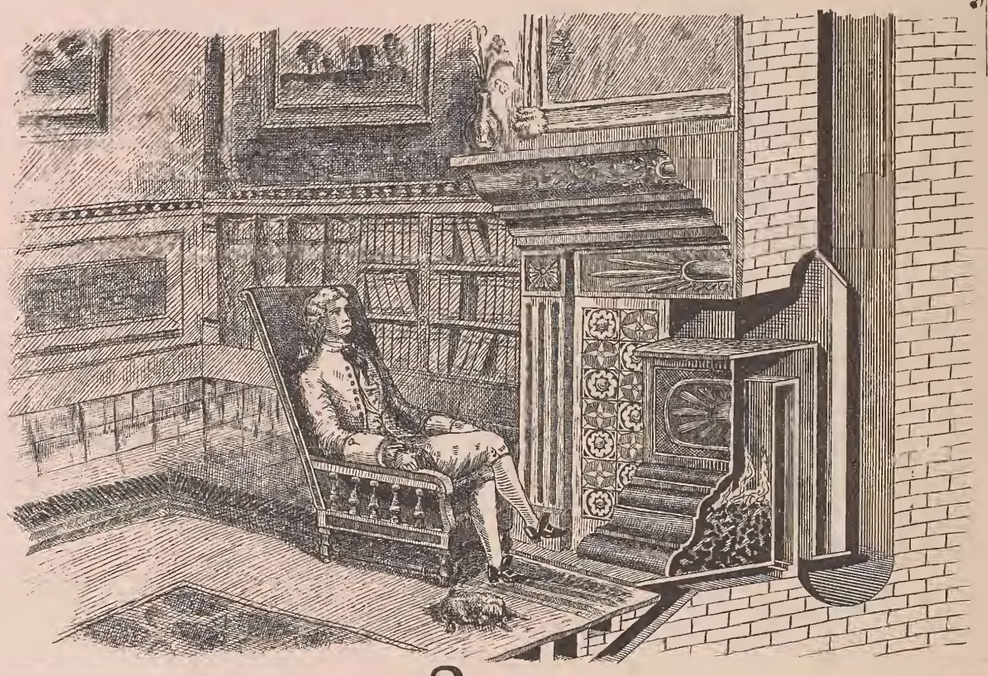
COOKING STOVES.

2,446 Patents Granted by the United States.

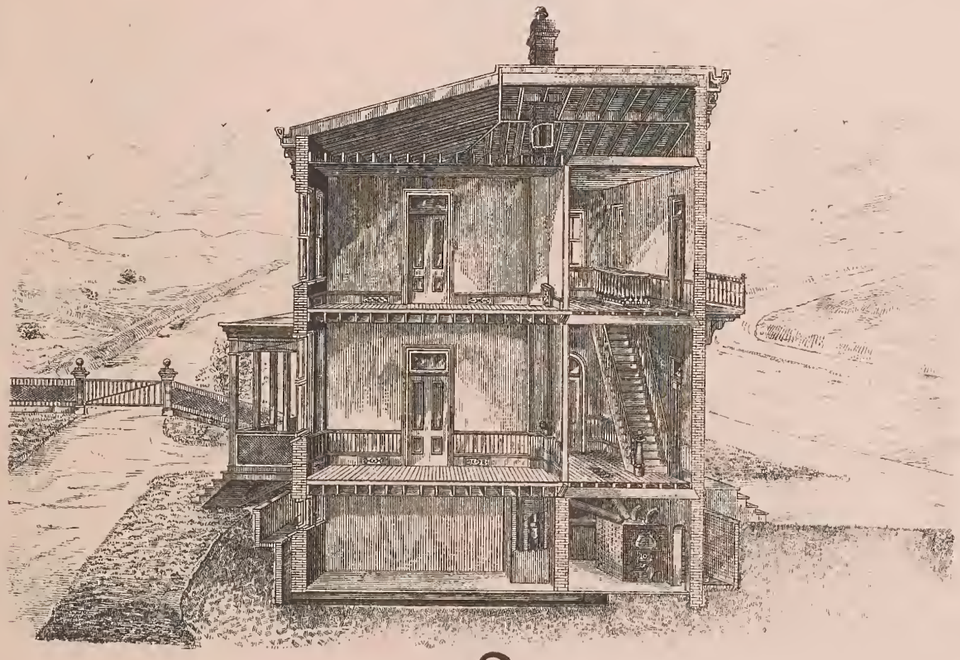
Sackett & Wilhelms Litho Co New York



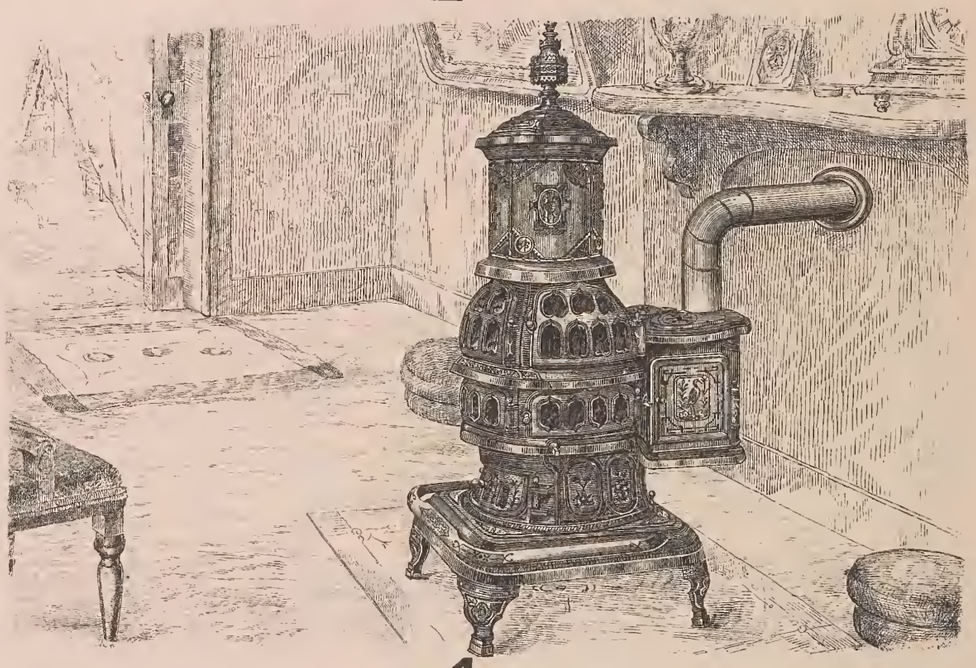
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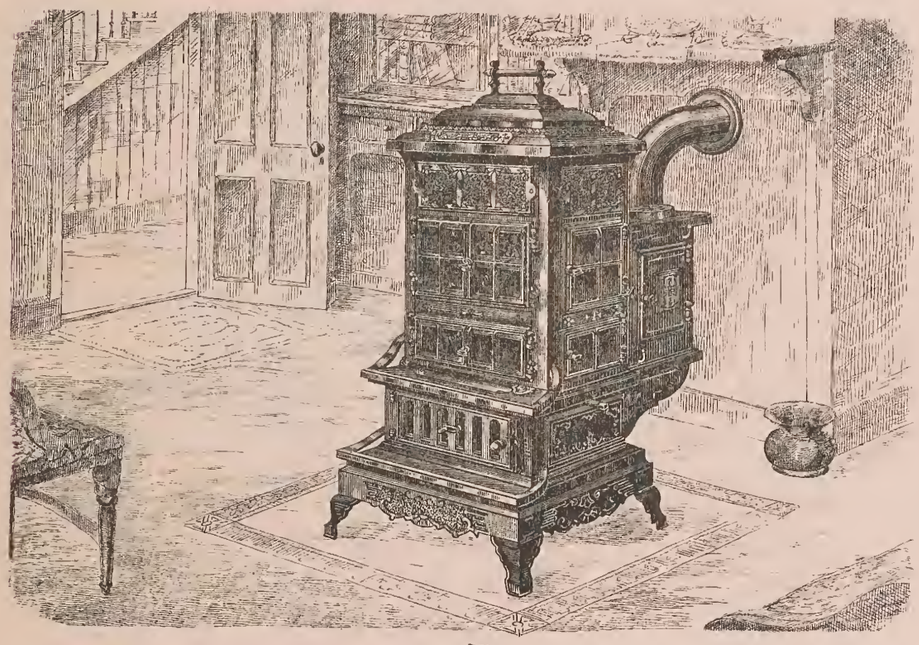
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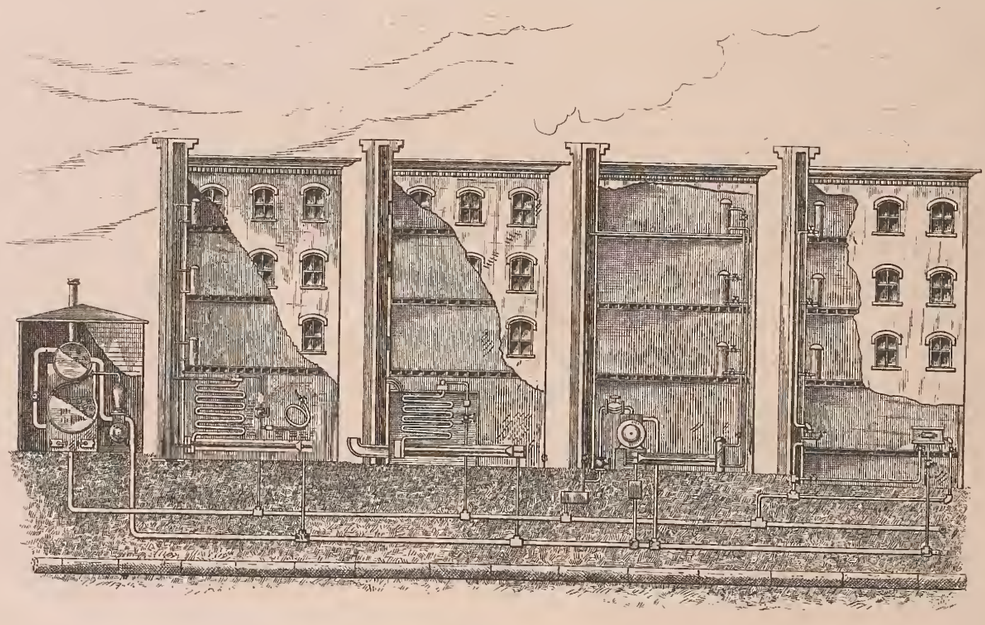
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HEATING.

HEATING.

No. 1. Primitive.

2. Benjamin Franklin's Stove—A. D. 1745.

3. U. S. Patent, Hot Air System—A. D. 1870.

4. " " Magazine Stove—A. D. 1875.

5. " " Magazine Stove and Warming Oven—A. D. 1889.

6. " " Steam Heating System—A. D. 1881.

The ancient Greeks and Romans warmed their houses by braziers, in which they used charcoal, and threw perfumes on the wood to correct any unpleasant effluvia. They also had a method of preparing wood to prevent smoking, which was by peeling off the bark and letting the wood lie a long time in water, and then drying it and likewise scorching it over the fire until it lost all moisture.

Stoves are of comparatively modern invention, and were probably first in use in the countries of the north of Europe. They were built of bricks and tiles of massive forms, and somewhat resembled ovens.

Dr. Franklin, who was one of the earliest writers on the subject, invented some very ingenious forms of stoves. His earliest inventions were made in 1745.

In 1771 Dr. Franklin completed and used in London a stove designed for burning bituminous coal, which consumed its own smoke.

Bonnemain appears to have been the first to introduce the circulation of hot water in a system of pipes as a means of warming apartments and buildings. He devised and put his plan in operation in 1777.

In Germany cast iron stoves are used to some extent.

Oliver Evans received, in 1800, the first United States patent for a "luminous stove" for burning the recently discovered hard Lehigh or stone coal.

The general introduction into the United States of grates and furnaces for burning anthracite coal did not commence until 1827.

The various methods which have been put into practice for producing a proper temperature in buildings may be reduced to the following: 1st, warming by fires placed in open chimney places; 2d, warming by flues under the floors or in walls; 3d, warming by close stoves of brick, earthenware or metal; 4th, warming by steam pipes; 5th, warming by hot water pipes; 6th, warming by heated air; 7th, warming by combinations of these methods.

Stoves in the United States are of the greatest diversity of forms. They are made of cast iron, of sheet iron, and sometimes of soapstone.

Stoves heated by jets of burning gas have been recently introduced.

HEATING.

4,147 Patents Granted by the United States.

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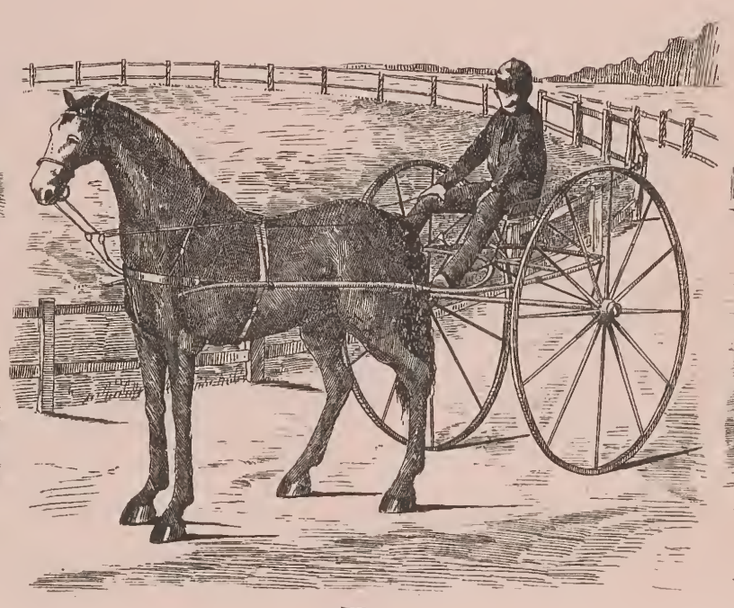
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CARRIAGES.

CARRIAGES.

No. 1. U. S. Patent, Elliptic Spring Road Buggy—A. D. 1826.
2. " " Jump Seat Carriage —A. D. 1858.
3. " " Rockaway—A. D. 1858.
4. " " Buck Board—A. D. 1876.
5. " " Trotting Sulky—A. D. 1880.
6. " " Buck Board Farm Wagon—A. D. 1883.
7. " " Road Cart—A. D. 1883.
8. " " Side Bar Buggy—A. D. 1884.
9. " " Side Spring Phæton—A. D. 1884.

The vehicle used by Joseph to carry his father to Canaan was an ox-cart.

In ancient times horses were only used to draw chariots.

The vehicles of Egypt were two-wheeled, and were known 2000 B. C.

The natives of China and India used carts from an early date.

The Orcera was a carriage used by sick and infirm persons.

A later invention was the Carpenturin; it is represented on antique coins as a two-wheeled car with an arched covering.

The Scythians covered their wagons with felt and leather.

The use of pleasure carriages in Rome was forbidden during the Republic.

The Romans had vehicles with one wheel, adapted to be drawn by horses.

Carriages, the bodies of which were suspended by means of leather straps, were brought into use during the reign of Louis XIV, in the year 1643.

In the sixteenth century carriages were introduced into Spain, Portugal and other countries.

Stage wagons were introduced into France in 1654.

The first carriage built in the United States is said to have been made in 1805, at Dorchester, Mass.

The woods usually used in the manufacture of carriages are hickory, black walnut, cherry, maple, yellow poplar, locust and gum.

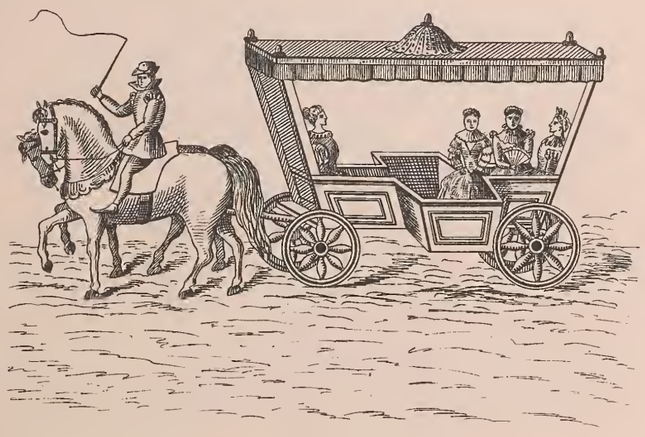
CARRIAGES.

3,841 Manufactories in the United States.

	1860	1880
Capital Invested, -	$14,131,537.00	$37,973,493.00
Value of Productions, -	26,848,905.00	64,951,617.00
Wages Paid, - -	10,001,891.00	18,988,615.00
Hands Employed, - -	27,461	45,394

11,013 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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COACHES.

COACHES.

No. 1. English, Queen Elizabeth.
2. " Charles II.
3. " Landeau—A. D. 1757.
4. " Britzska.
5. " Post Chaise.
6. Elliptic Spring—A. D. 1805.
7. U. S. Patent, Stage Coach—A. D. 1830.
8. " " Clarence—A. D. 1880.
9. " " Caleche—A. D. 1883.

Covered coaches were known in the fifteenth century, and were used only by women of the first rank, as men thought it disgraceful to ride in them.

Walter Rippin made the first coaches in England in 1555. They were heavy, without springs, and the driver rode on one of the horses.

Coaches to be let for hire were first established in London in 1625.

Glass windows were added to coaches in 1631.

In Amsterdam coaches with wheels were forbidden in 1663, in order to save the pavements of the streets; the bodies were placed on runners.

The Hungarians claim the invention of the modern coach, and say it derived its name from Kotsee, and their king, Cervius, was the first who rode in one.

Coaches were first used in Boston, Mass., in 1669.

Stage coaches were introduced into England by Jethro Tull in 1750, and first employed to carry the mails in 1784. There were six carriage shops in New York City in 1788.

Hackney coaches, drawn by two horses, have generally given place in London to the one-horse cabs, which came into use in 1823.

The long coach, or omnibus, first appeared in Paris in 1827, and in 1830 it was first run on Broadway, New York City.

The English stage coach carries six inside and fourteen outside, in addition to the driver and guard.

Stage and mail coaches are of similar construction, and are used for the same purpose in the United States. They may be drawn by two, four or six horses.

The modern American mail coaches, running at the rate of ten miles an hour over the best turnpike roads, changing horses at every stage, were the finest in the world, but they have been superseded by the net-work of railroads which now cover the country.

COACHES.

3,841 Manufactories of Carriages and Wagons in the United States.

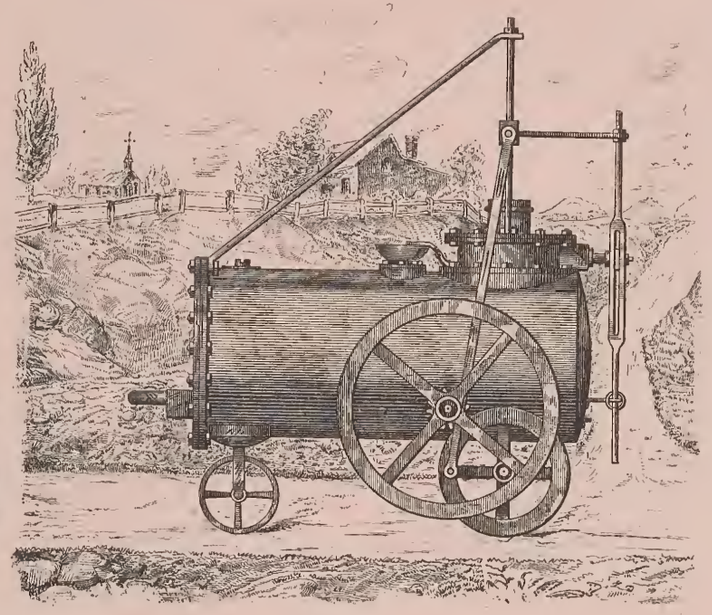
	1860	1880
Capital Invested,	$14,131,537.00	$37,973,493.00
Value of Productions,	26,848,905.00	64,951,617.00
Wages Paid,	10,001,891.00	18,988,615.00
Hands Employed,	27,461	45,394

174 Patents Granted by the United States.

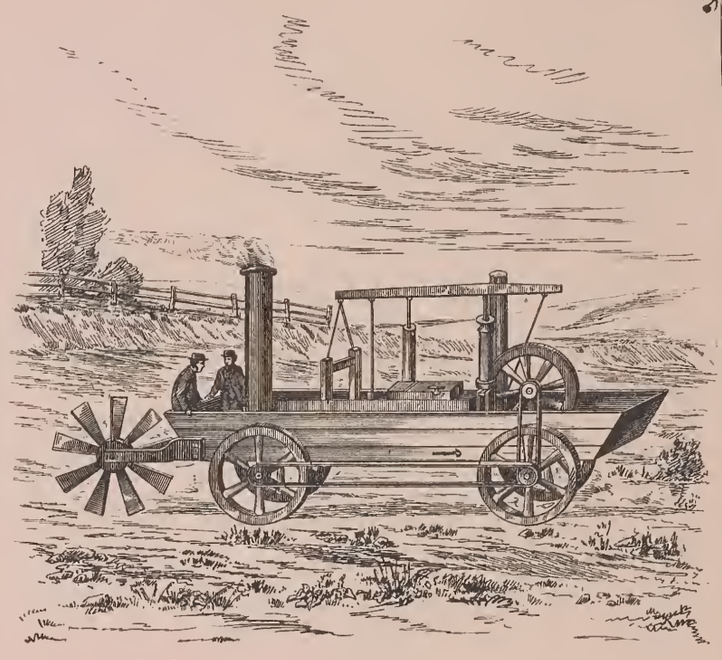
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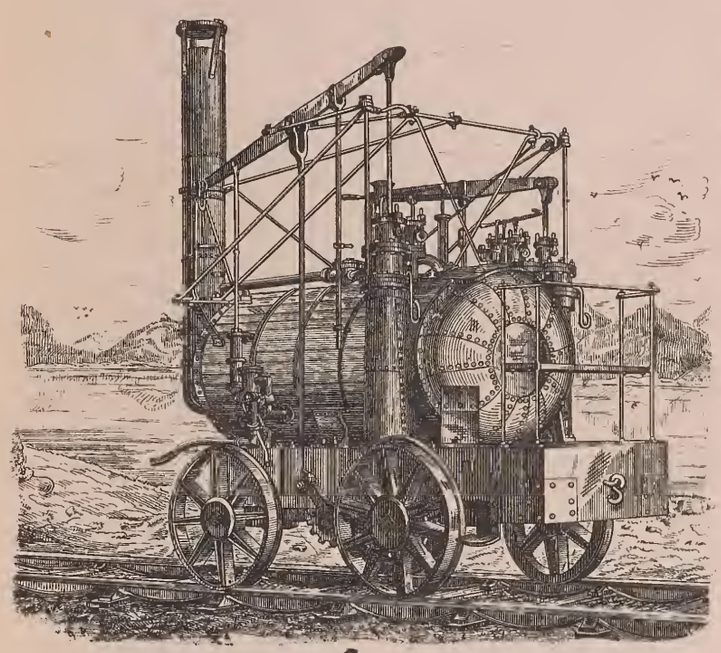
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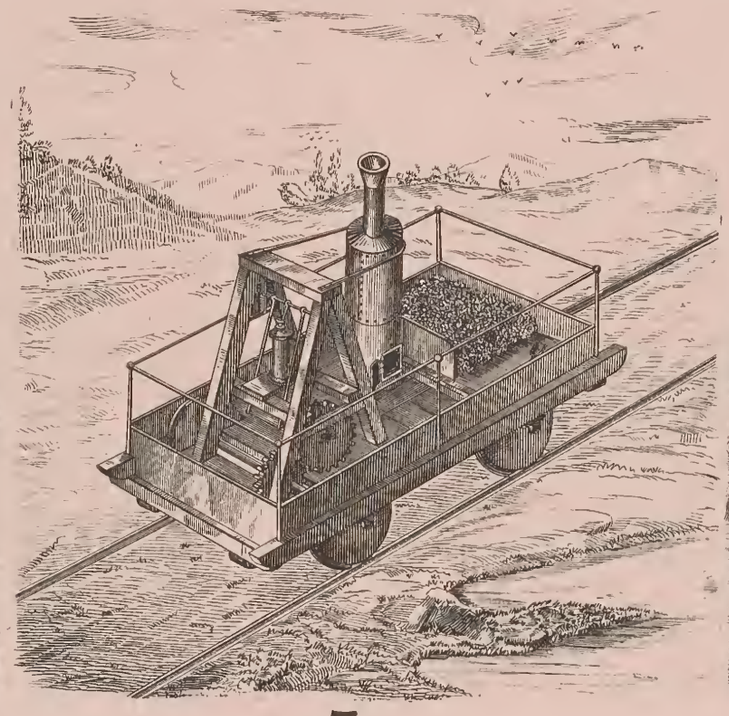
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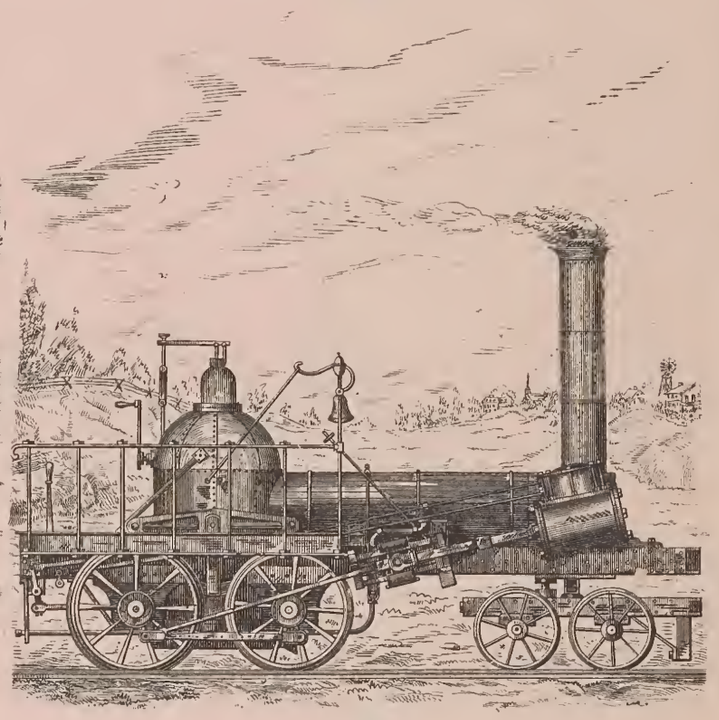
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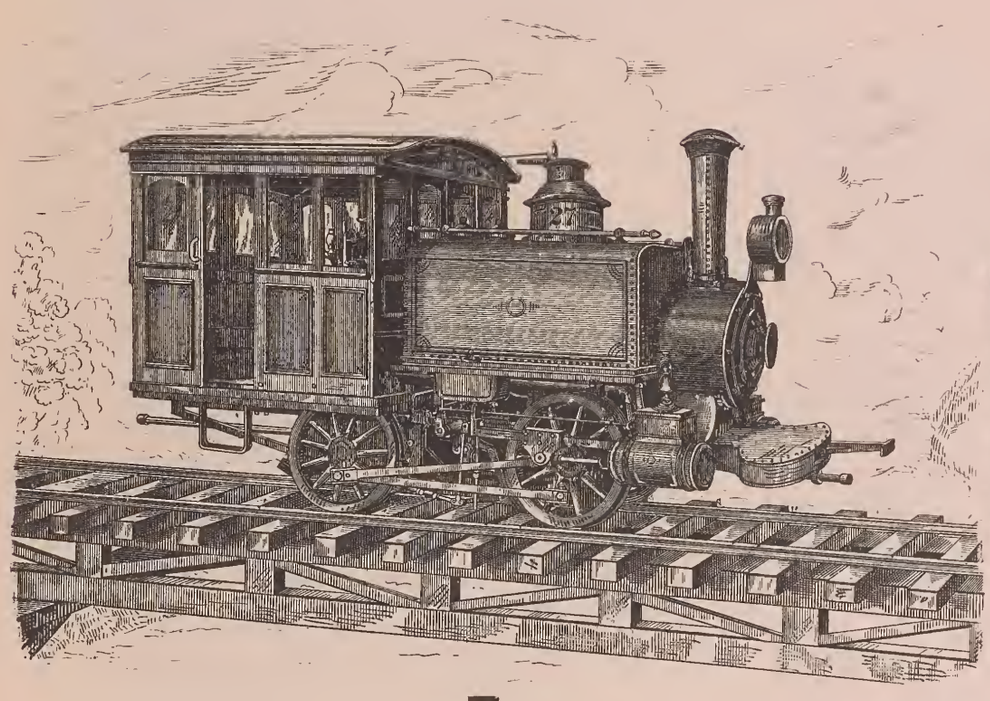
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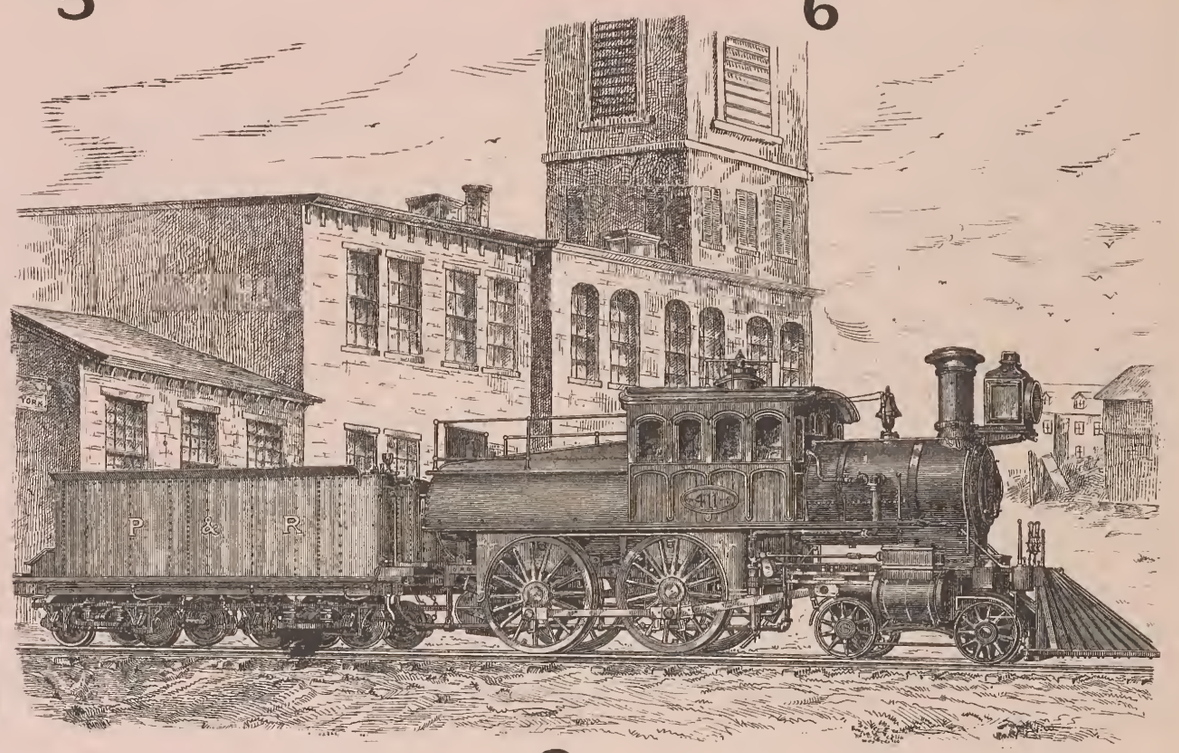
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8

LOCOMOTIVES.

LOCOMOTIVES.

Nn. 1. English—A. D. 1802.
2. United States—A. D. 1804.
3. English, "Puffing Billy"—A. D. 1813.
4. " "Rocket"—A. D. 1829.
5. U. S. Patent, "Tom Thumb"—A. D. 1830.
6. English, "Hercules"—A. D. 1837.
7. U. S. Patent, Elevated Road Tank—A. D. 1883.
8. " " Passenger—A. D. 1884.

Cugnot, of France, made a locomotive in the year 1769.

Symington showed a model of a steam carriage, in Scotland, in 1770.

Murdock made, and exhibited in England in 1784, a locomotive in which steam was generated by the heat of a lamp.

Oliver Evans, of Philadelphia, Penn., U. S., obtained a patent in 1787, to make steam wagons.

In 1802, Trevithick patented, in England, a high pressure locomotive engine. When slightly loaded it did very well upon a level surface or moderate grade, but when more severely tasked the wheels would slip around without advancing. This was the first to run on rails or trams.

Oliver Evans made the double acting, high pressure steam engine a success, in 1803.

In 1806, a locomotive to be driven by hot air, was constructed by Niepce, of France.

Blenkinsop's invention of 1811 gave great satisfaction to its owners, and was long used on a railway between Leeds and Middletown, England. It pulled a train of 30 tons, and made 3¼ miles per hour.

Brackett made experiments, in 1812, to prove that the pinion and rack rail were unnecessary.

Chapman, in 1812, patented a locomotive with eight wheels, driven by gearing, for the purpose of increasing the traction and adhesion.

In the same year Brunten devised a means of driving a locomotive by two propellers, consisting of jointed rods, to imitate the action of the hind legs of a horse.

In 1813, Hedley built a locomotive, with four smooth drive wheels, to run on smooth rails; it failed, however, to accomplish the desired end.

Dodds and Stephenson, of England, patented an engine in 1815.

The French engineer, Sequin, in 1826, introduced locomotives upon the railways of France.

The Liverpool and Manchester Railway, of England, in 1829, offered 500 pounds premium for a locomotive which should fulfill certain conditions. In October of that year, four locomotives were presented for trial, and the prize was awarded to "the Rocket," built by Messrs. Stephenson and Booth.

The first locomotive run on rails in the United States was built by George Stephenson, of England, in 1829, for the Delaware and Hudson Canal and Railway Co.

It was soon found that the English locomotives were unsuited for American railways, where curves of a radius of 200 feet were sometimes employed.

In 1830, the first American locomotive, called "the Phœnix," was built at West Point, N. Y.

In the same year, Peter Cooper, of New York, devised and built a small engine, in Baltimore, Md., for the Baltimore and Ohio R. R. Co., which overcame the difficulty of short curves; this locomotive was regularly run between Baltimore and Ellicott's Mills, Md.

To the South Carolina Railroad Company the honor must be awarded of being the first to adopt locomotives as the tractive power on a railroad 150 miles long, and the first to make a continuous locomotive trip over a distance of 100 miles.

The locomotive works in the United States now number sixteen, not including the shops owned by railway companies. Pennsylvania has five of these, New Jersey and Massachusetts, three each; New York, two; and Rhode Island, New Hampshire and Maine, one each. These works give employment to 14,000 men, and every year adds about 2,600 locomotives to the 20,000 now in use.

It is estimated that it would require 60,000,000 horses to perform the work of the total steam power used in the world.

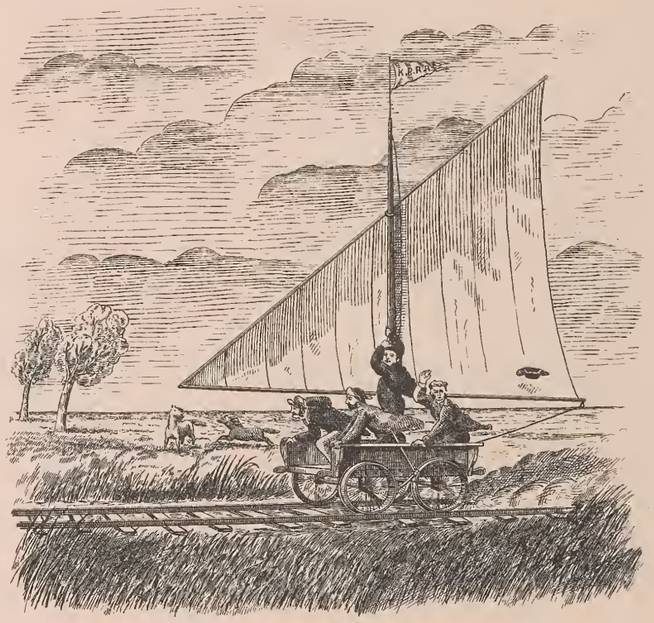
LOCOMOTIVES.

259 Patents Granted by the United States.

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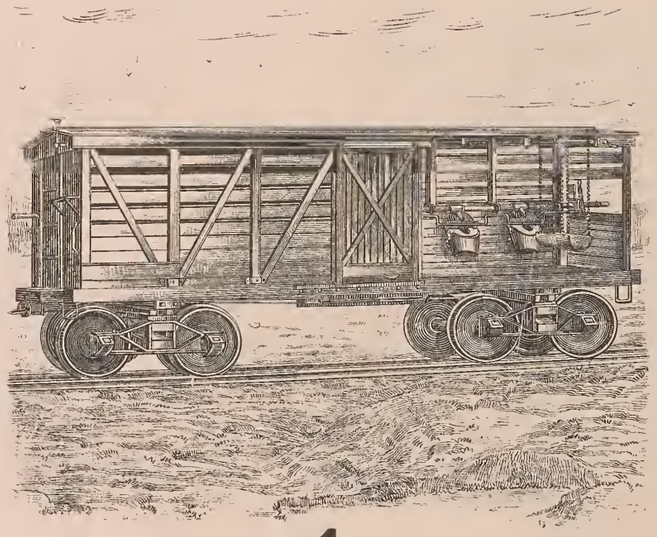
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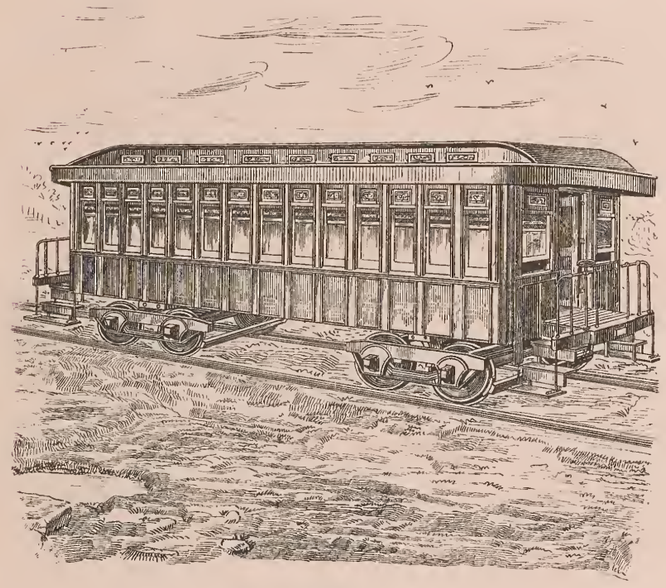
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RAILWAY CARS.

RAILWAY CARS.

No. 1. First Passenger Car—A. D. 1825.
2. Sailing Car—A. D. 1878.
3. Passenger Car—A. D. 1882.
4. U. S. Patent, Stock Car—A. D. 1882.
5. " " Passenger Car—A. D. 1883.
6. " " Street Car—A. D. 1884.

The first railway cars in England were those used on the Liverpool and Manchester railroad, in 1830. They had four wheels, no springs nor roofs, and were similar to the present rack cars.

The Baltimore and Ohio was the first passenger railway in America, being opened in 1830. The cars were drawn by horses until a locomotive was brought into use in 1831.

In 1831 springs and conical tread wheels were proposed by Joseph Knight.

Hansom, in 1847, introduced in England an iron car, which was divided into compartments, each of which contained a single seat.

Paper car wheels have been introduced in the United States with success. The advantages claimed are that they are noiseless, do not spring or shrink, afford a stay to the tire and a lateral support in turning curves, and are stronger than any other material of the same weight of which wheels can be made.

It has been proposed to build cars of a tapering shape, so as to present less resistance to the air whilst the train is in motion.

American passenger cars are constructed on a very different plan from those of Europe. The long, single apartment passenger car, with swing trucks, and the drawing room, sleeping and hotel cars, all are of American origin.

Over 8,000,000 railway car wheels are daily running in the United States, and there is a demand for from 3,000 to 4,000 wheels every working day to replace those worn out and broken in service. It is estimated that there are about 120,000 passenger and 500,000 freight cars in the world.

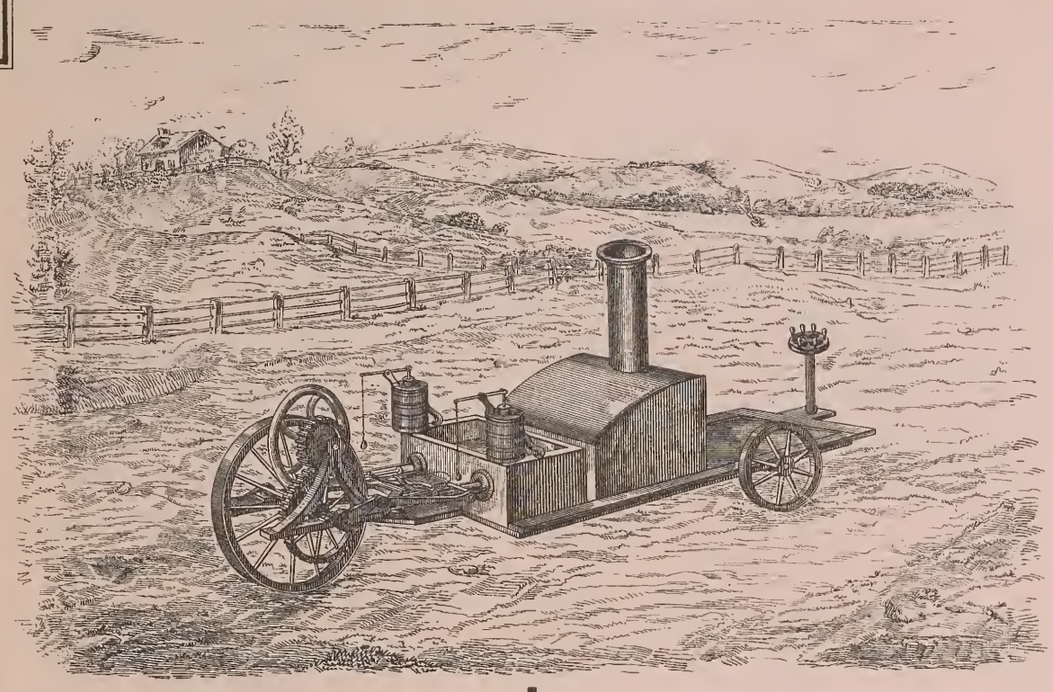
RAILWAY CARS.

1,017 Railroad Companies in the United States.

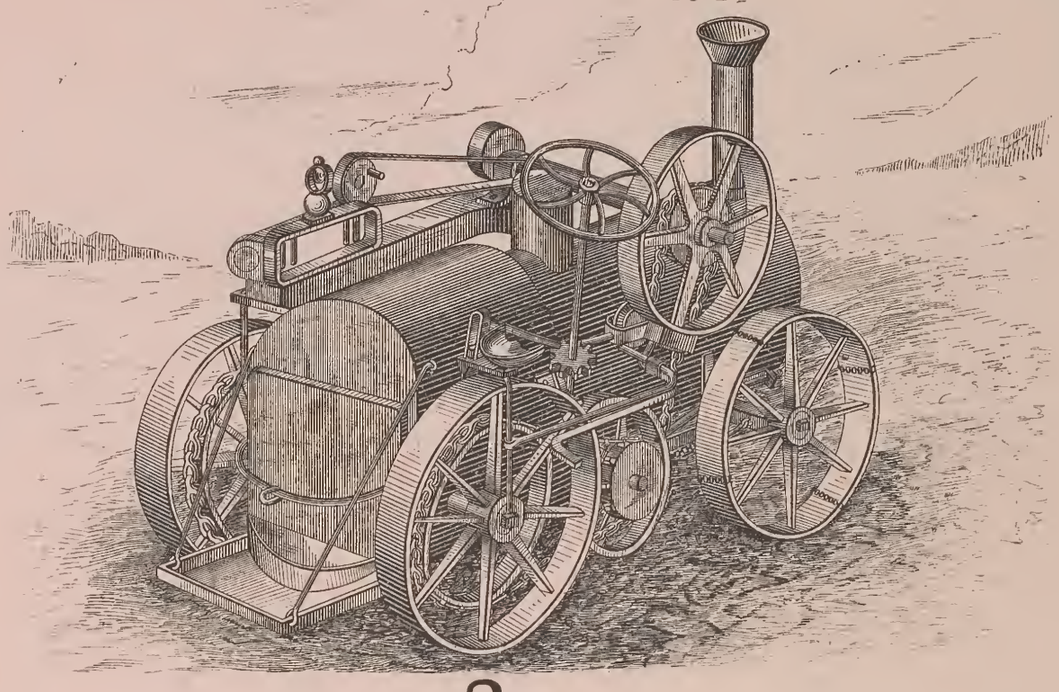
	1880
Miles of Road Operated,	87,781
Capital Invested,	$5,182,445,867.00
Wages Paid,	195,350,013.0[illegible]
Hands Employed,	41[illegible]

7,875 Patents Granted by the United States.

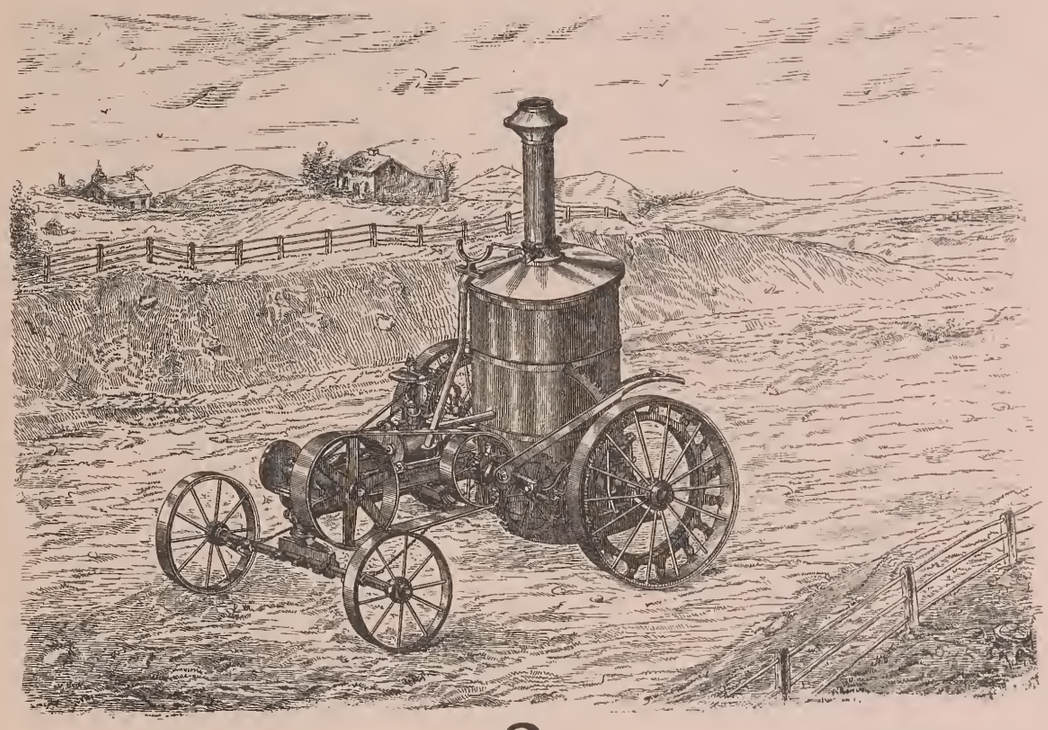
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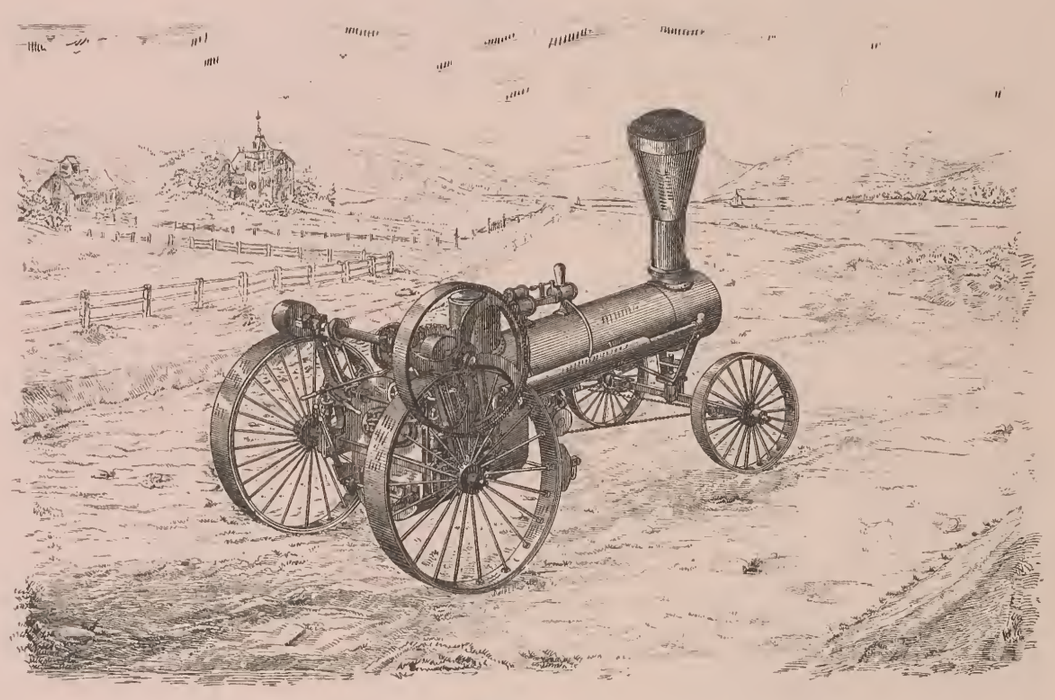
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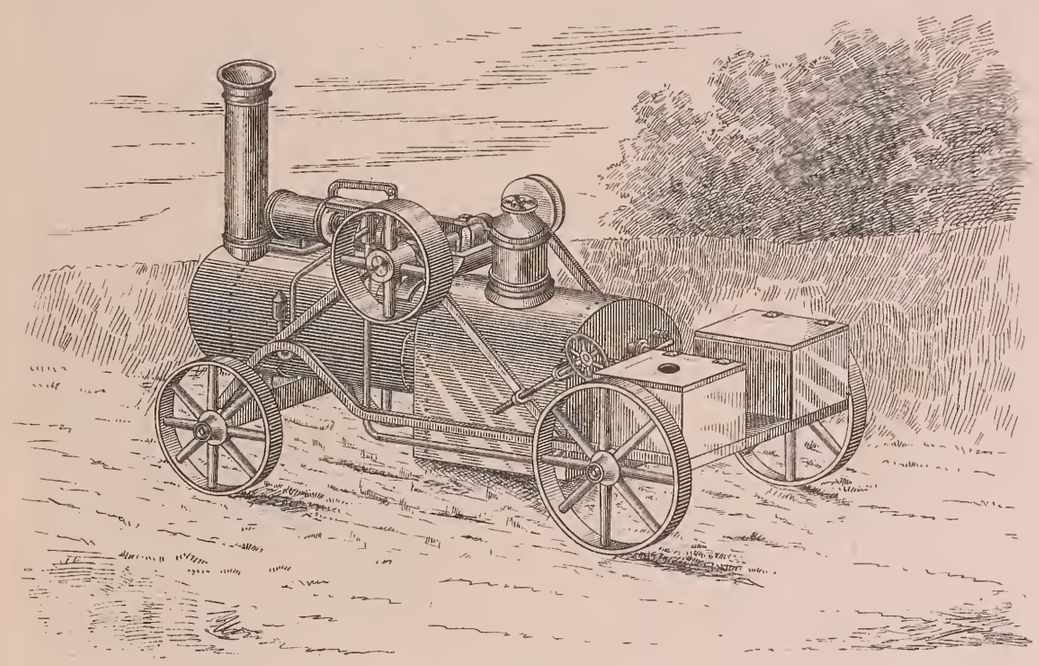
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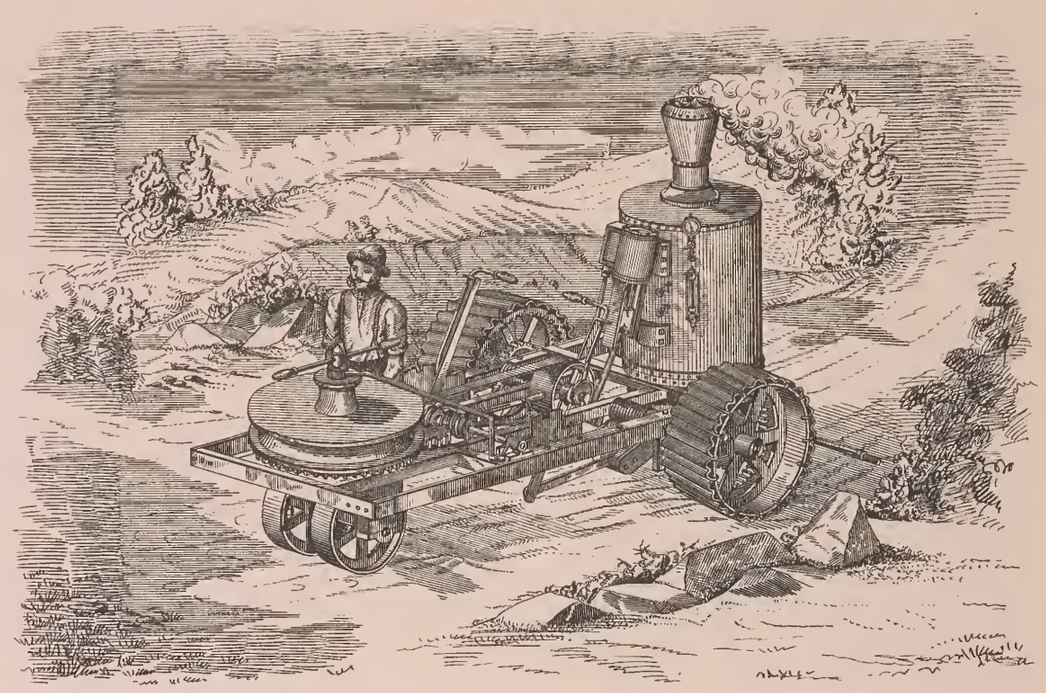
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ROAD ENGINES.

ROAD ENGINES.

No. 1. U. S. Patent, Steam Wagon—A. D. 1817.
2. " " Traction Engine—A. D. 1873.
3. " " Power Steering Road Engine—A. D. 1881.
4. " " Road and Agricultural Engine—A. D. 1882.
5. " " Adjustable Leveling Road Engine—A. D. 1883.
" " Winding Drum Road Engine—A. D. 1884.

Murdock, a Scotch engineer, about 1786 constructed a small locomotive, which ran on the high road near Redruth, Scotland.

Symington, of Scotland, and Oliver Evans, of America, also constructed models designed for the same purpose.

One of the earlier forms of traction engines was Boydell's. This had endless chains of boards fitted to its wheels, forming a sort of endless railway, which was laid down and taken up by the engine as it proceeded.

The success of railways, and the difficulties attending the use of locomotives on ordinary roads, caused a cessation of efforts toward the improvement of road engines until about the year 1856, when the subject was revived with a view to the adaptation of such engines to agricultural purposes. Of late years several varieties have been constructed which fulfill their intended purpose with considerable success.

A traction engine for running on ice has been employed for carrying passengers between St. Petersburg and Cronstadt, in Russia.

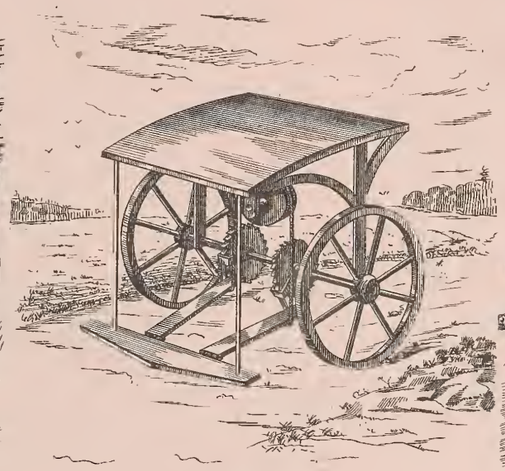
ROAD ENGINES.

469 Patents Granted by the United States.

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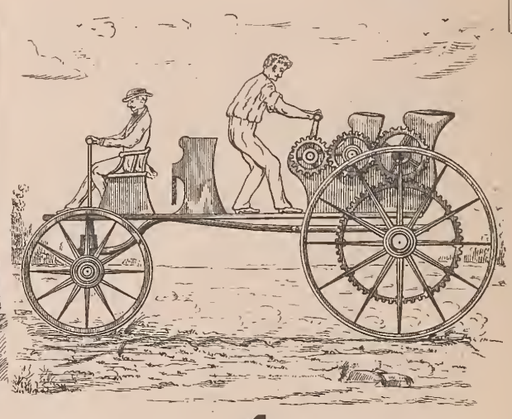
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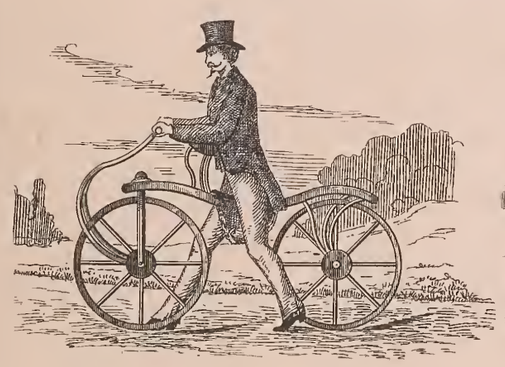
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VELOCIPEDES.

VELOCIPEDES.

No. 1. Hand Propeller—A. D. 1700.
2. French Pedal—A. D. 1750.
3. " Hand Propeller—A. D. 1770.
4. American Hand Propeller—A. D. 1804.
5. English Dandy Horse—A. D. 1818.
6. U. S. Patent, Tricycle—A. D. 1864.
7. " " " —A. D. 1865.
8. " " Bicycle—A. D. 1866.
9. " " Unicycle—A. D. 1869.
10. " " Bicycle—A. D. 1880.
11. " " Tandem—A. D. 1882.
12. " " Ice—A. D. 1883.
13. " " Tricycle—A. D. 1883.
14. " " Bicycle—A. D. 1884.
15. " " " —A. D. 1884.
16. " " Sociable—A. D. 1884.

In the early part of the year 1816 a very curious machine was constructed and used near Rochelle, France. It consisted of two wheels of equal size, placed one in front of the other, connected by a bar on which was a small seat. It was operated by the rider striking his feet against the ground.

This appears to have been the progenitor of the bicycle.

In the early part of the present century a machine called the celeripede was invented. The English "Dandy Horse" came into use about sixty years ago.

The first application of the wrench axle was patented in the United States, by P. W. Mackenzie, in 1862.

In the years 1868 and 1869 the velocipede came into sudden popularity, but was superseded by the bicycle, which was imported from England.

The first approved bicycle was exhibited at the Centennial Exhibition, in 1876.

The first American company for the manufacture of bicycles was organized in 1878.

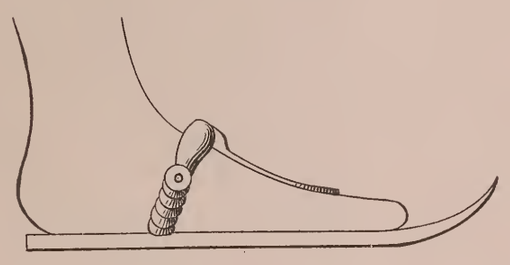
It is estimated that 6,000 were manufactured and sold in the United States in 1884, and that 30,000 were in use in the United States in 1885.

VELOCIPEDES.

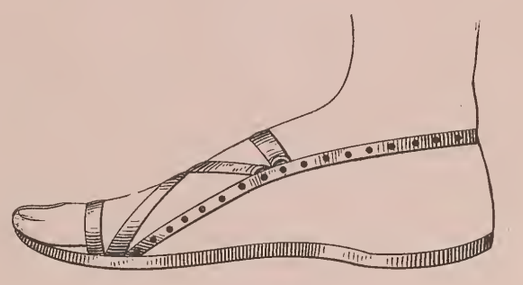
	1878	1884
Number Manufactories,	1	8
" in use in the United States,	25	30,000
" Manufactured,	150	9,000

700 Patents Granted by the United States.

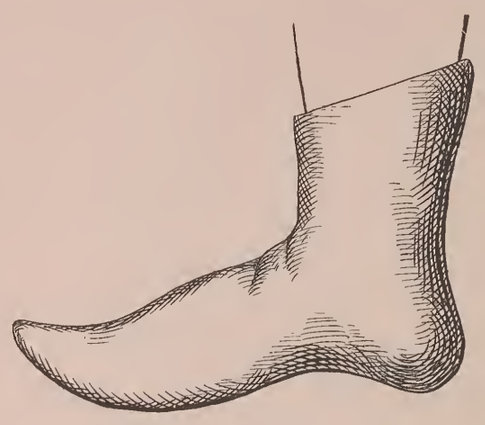
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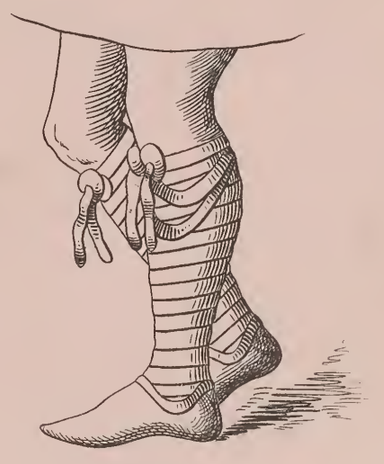
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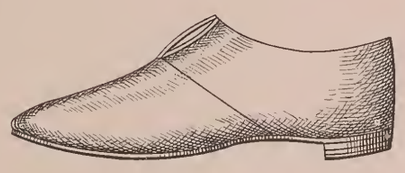
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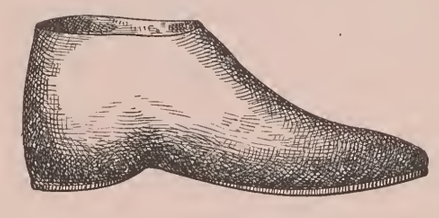
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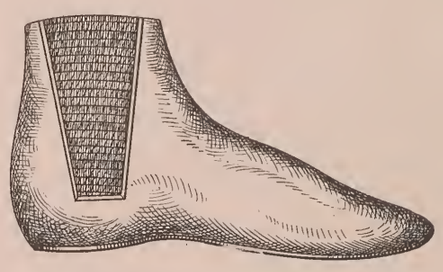
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BOOTS AND SHOES.

BOOTS AND SHOES.

No. 1. Egyptian Sandal of Palm—1495 B. C.
2. Assyrian Sandal—669 B. C.
3. Persian Boot—500 B. C.
4 Roman Cothurmus—A. D. 275.
5. Anglo-Saxon Bandaged Leather Hose—8th Century.
6. French Boot—17th Century.
7. U. S. Patent, Pegged Shoe—A. D. 1811.
8. " " Rubber Shoe—A. D. 1834.
9. " " Congress Gaiter—A. D. 1840.
10. " " Machine Sewed—A. D. 1860.
11. " " Cable Screw Wire—A. D. 1867.
12. Modern Boot and Shoe.

Homer speaks of the "brazen-booted" Greeks.

Moses said of Asher: "Thy shoes shall be iron and brass."

The Egyptians and Hebrews had some protection for their feet at the time of Abraham, for the patriarch refused to "take even as much as a shoe latchet from the King of Sodom, lest he should say he had made him [Abraham] rich."

The Chinese have made shoes, from time immemorial, from skin, silk, rushes, linen, wool, wood and metal.

Succeeding ages introduced foot coverings of various kinds; the sandal, the moccasin, slippers, buskins, &c.

Syrian boots were of leather, and had an extra thickness sewed below to answer for a sole.

Hesiod, 1,000 B. C., mentions "oxhide boots as part of the winter equipments of a plowman."

Among the trades practiced by the Egyptians was shoemaking. An illustration on the tombs at Thebes is shown of a shoemaker at his bench engaged in boring holes with an awl in a leather sole.

The Egyptians made shoes of leather, papyrus and textile fabrics. The upper was sewed to the sole without a heel.

Pliny said "Tychius invented the leather shoe." The "Caliga" of the Romans was the coarse shoe of the soldier, the sole being thickly studded with nails.

The Roman Emperors wore shoes enriched with jewels and embroidered with gold and silver. The shoes of the Emperor Marcus Aurelius had separate apartments for the toes.

The shoes of the Roman senators reached to the middle of the leg.

Julius Cæsar wore high heeled shoes to increase his stature.

In England, shoes of a similar form to those of the present time were worn by the lower classes as early as the 8th century.

From the 12th to the 15th century fashionable shoes in England were made with long toes stuffed with tow; these toes or beaks were so long that it was common to fasten them to the knees of the wearer by a silver chain; in 1463 Parliament limited the length of this useless projection to two inches.

In the American Colonies few, if any, shoes were made from calf skin. Cow hide was used almost exclusively for foot gear.

As early as 1635 the town of Lynn, Mass., had a shoemaker. In 1877 the product of the Lynn factories was not less than 14,000,000 pairs of boots and shoes.

A single shoe factory in Massachusetts turns out as many pairs of boots as 30,000 boot makers in Paris, France.

The manufacture of boots and shoes in the United States in 1880 is reported as producing to the value of $166,050,354; the materials consumed included 6,831,661 sides of sole leather, 21,147,656 sides of upper leather, and 32,960,614 pounds of other leather; the products were 30,690,896 pairs of boots and 98,887,615 pairs of shoes.

BOOTS AND SHOES.

18,369 Manufactories in the United States.

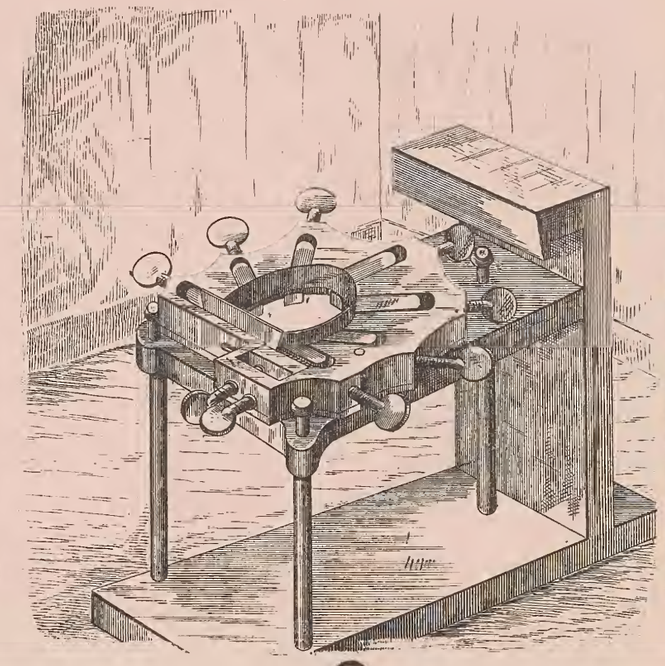
	1860	1880
Capital Invested, - -	$23,357,627.00	$58,973,665.00
Value of Productions, - -	91,889,298.00	217,093,627.00
Wages Paid, - - -	30,938,080.00	53,820,864.00
Hands Employed, - - - -	123,026	143,201

1,974 Patents Granted by the United States.

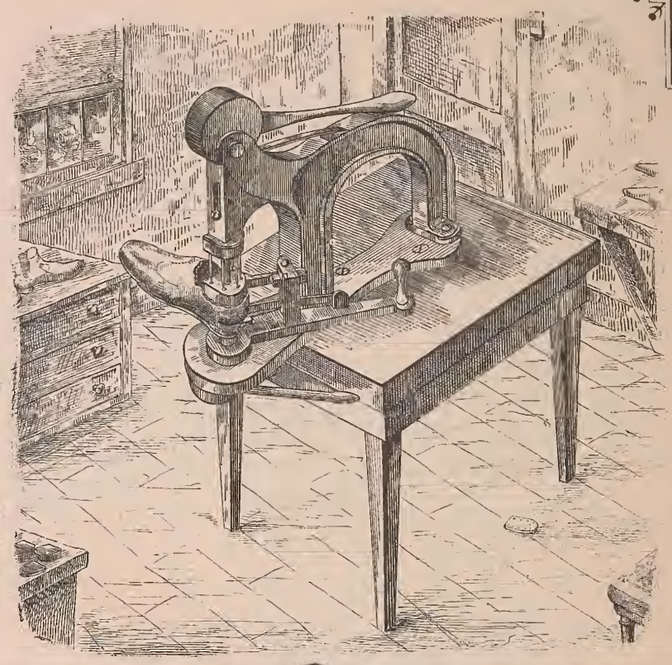
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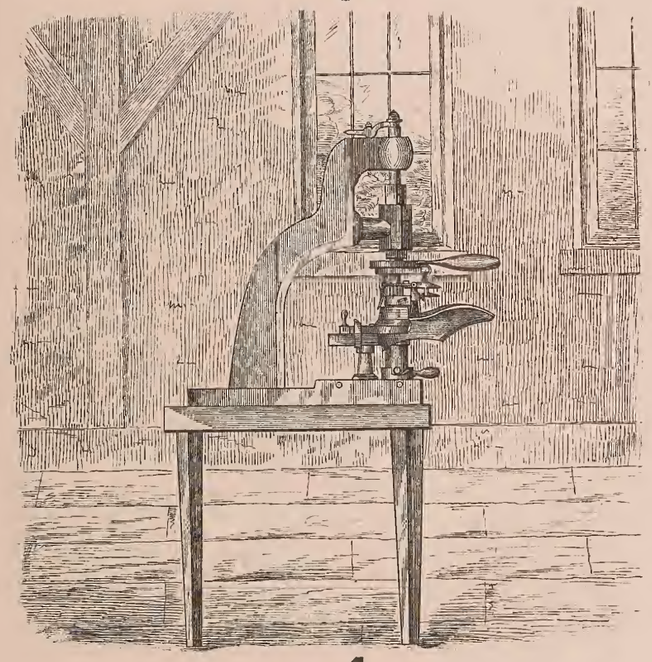
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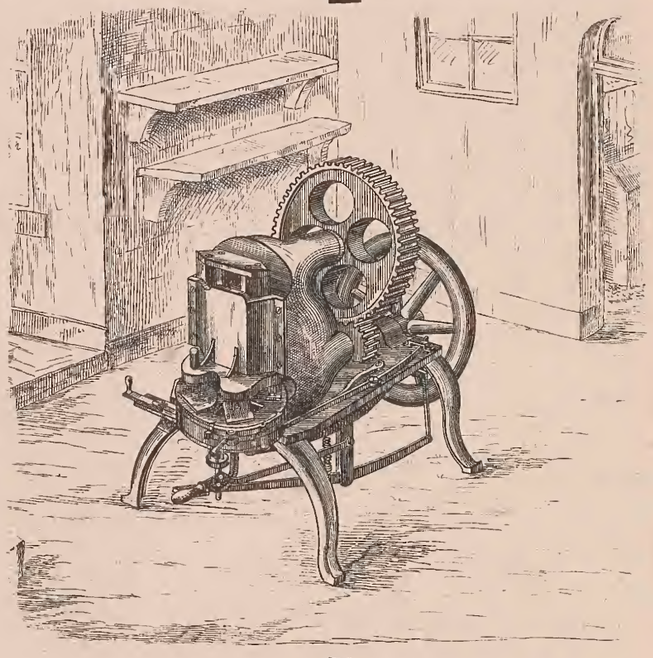
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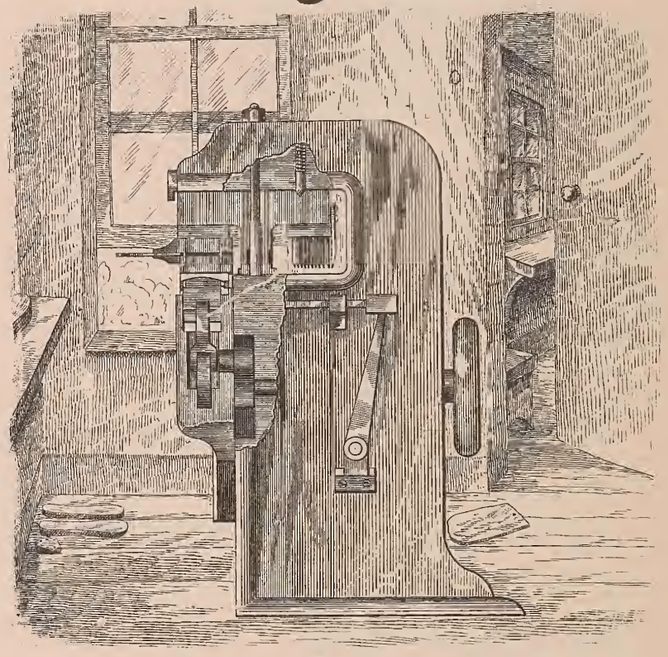
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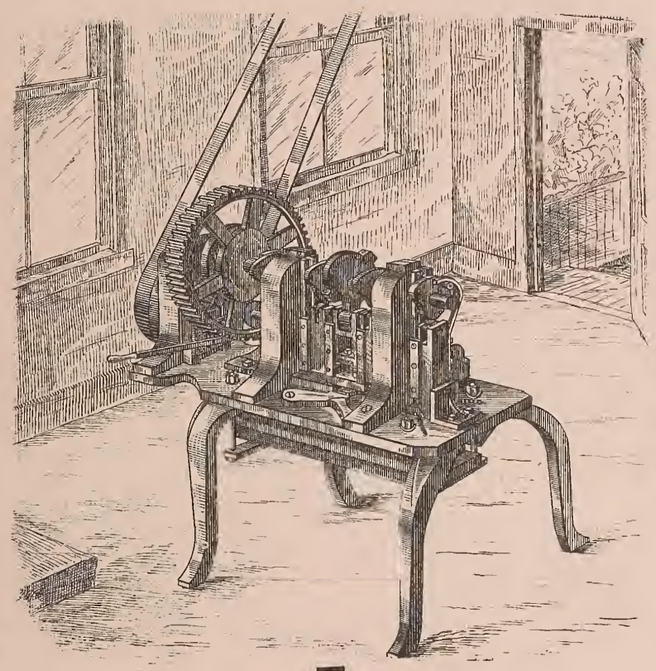
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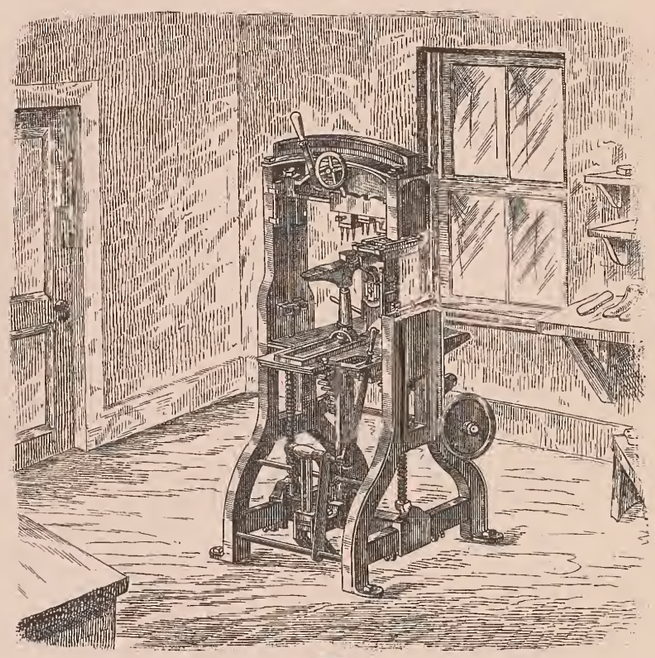
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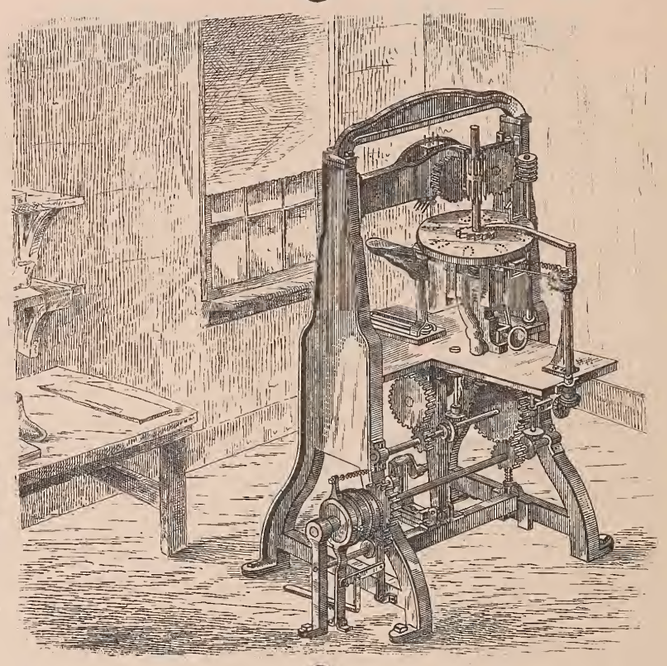
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9

BOOT AND SHOE HEELING.

BOOT AND SHOE HEELING MACHINES.

No. 1. Primitive Shoe Making.
2. U. S. Patent, Heel Trimmer—A. D. 1859.
3. " " Inside Heeler—A. D. 1860.
4. " " Heel Trimmer—A. D. 1862.
5. " " Heeler—A. D. 1870.
6. " " Pricker and Compresser—A. D. 1875.
7. " " Former and Pricker—A. D. 1881.
8. " " Pricker—A. D. 1882.
9. " " Rotary Heel Press—A. D. 1883.

In 1809 a U. S. patent was granted to D. M. Randolph for a method of riveting boot and shoe soles and heels to their uppers, instead of sewing them together as had theretofore been the practice.

In the improved boot and shoe heeling machines of to-day, mechanism is provided for punching holes in the heel blank for placing the nails and driving them; also for trimming the heel—all attached to the same standard.

In others, the machine is arranged to make the nails of different or varying lengths, by cutting nail strips or plates, and to separate the nails in the order desired, delivering them to a distributer, which receives, arranges, and delivers them to the nail-driving devices.

BOOT AND SHOE HEELING MACHINES.

18,369 Manufactories of Boots and Shoes in the United States.

	1860	1880
Capital Invested,	$23,357,627.00	$58,973,665.00
Value of Productions,	91,889,298.00	217,093,627.00
Wages Paid,	30,938,080.00	53,820,864.00
Hands Employed,	123,026	143,201

Manufactured in 1880.

Boots, prs.	Value.	Shoes, prs.	Value.
30,590,896	$53,223,265.00	94,887,615	$112,109,343.00

Capacity—	Primitive Mode.	Present Machine.
Pairs per day,	60 to 80	1,000
Hands Employed per day,	1½	1½

661 Patents Granted by the United States.

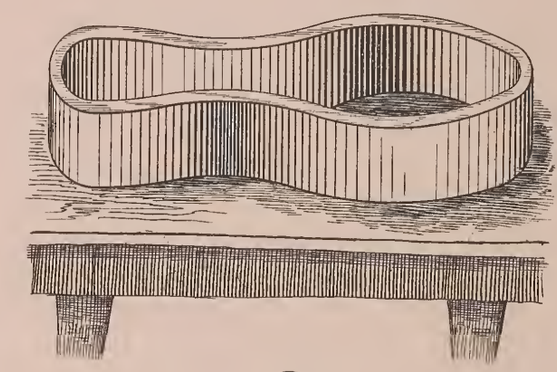
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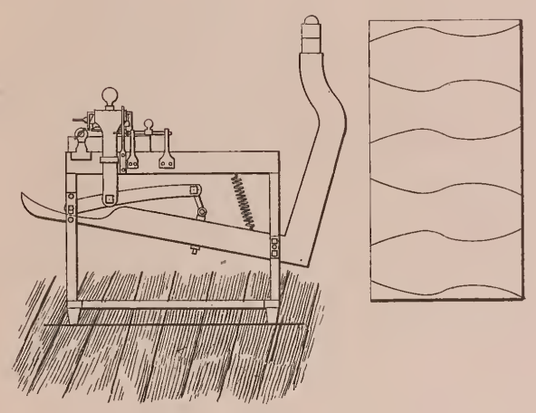
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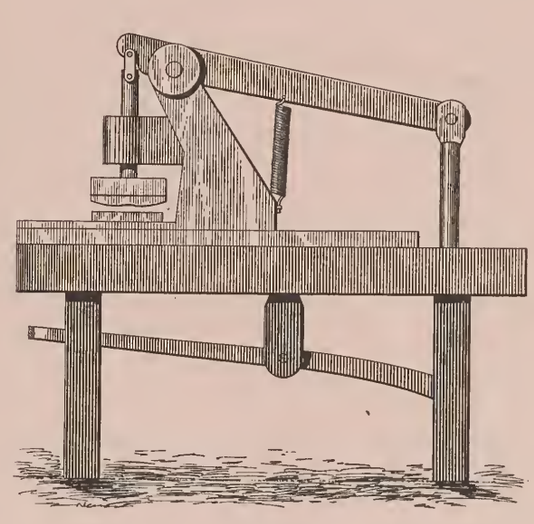
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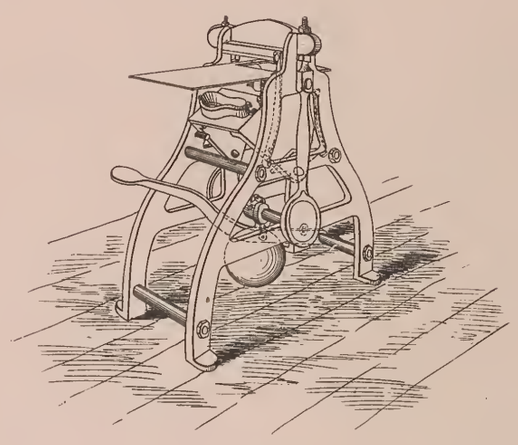
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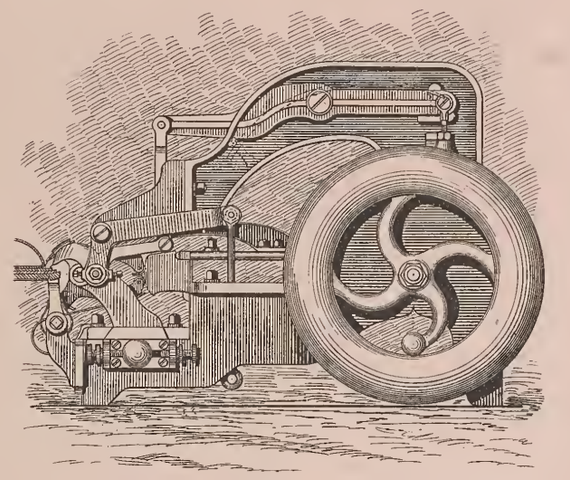
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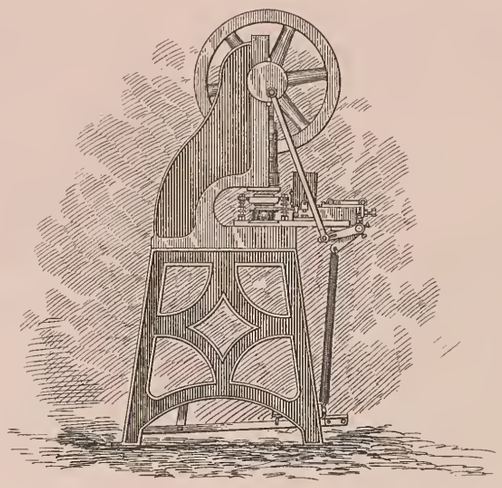
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BOOT AND SHOE SOLE CUTTING MACHINE.

BOOT AND SHOE SOLE CUTTING.

No. 1. Egyptian Sandal Sole Cutter—B. C. 1450.
2. English Cutter, 18th Century.
3. First Die for Cutting.
4. U. S. Patent, Sole Cutter—A. D. 1842.
5. " " Stamping Out Soles—A. D. 1854.
6. " " Sole Cutter—A. D. 1859.
7. " " Pricking and Trimming Soles—A. D. 1879.
8. " " Sole Cutter—A. D. 1882.

The cutting out of the soles of boots and shoes is now generally done by machinery.

A knife with a curvilinear edge is set in a frame and worked with a treadle, after the manner of a lathe.

By a lateral motion in the machine it can be adapted to the cutting of any requisite width of sole, and, being once fixed to a given width, the process of cutting is very rapid.

Material is saved by the leather being cut at right angles to the surface, instead of diagonally as by the ordinary knife.

The ordinary hand sole-cutters have dies of the shape of the sole driven by a mallet, or a sheet-metal pattern is laid on the leather and its edge followed by a knife.

BOOT AND SHOE SOLE CUTTING.

18,369 Manufactories of Boots and Shoes in the United States.

	1860	1880
Capital Invested,	$23,357,627.00	$58,973,665.00
Value of Productions,	91,889,298.00	217,093,627.00
Wages Paid,	30,938,080.00	53,820,804.00
Hands Employed,	123,026	143,201

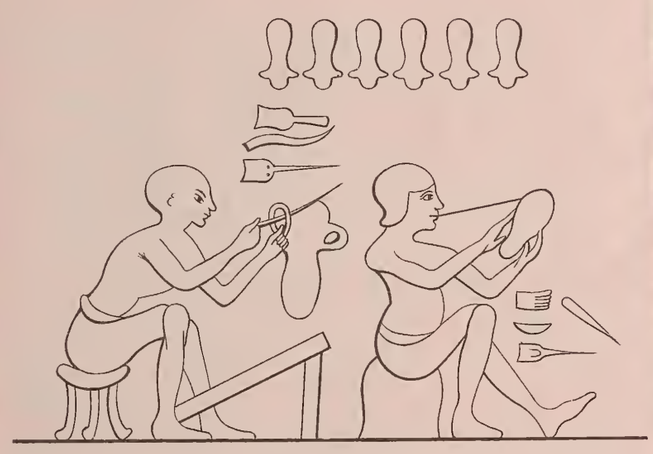
Manufactured in 1880.

Boots, prs.	Value.	Shoes, prs.	Value.
30,590,896	$53,223,265.00	94,889,615	$112,109,343.00

Capacity—	Primitive Mode.	Present Machine.
Pairs per day,	50	600
Hands employed per day,	1½	1½

134 Patents Granted by the United States.

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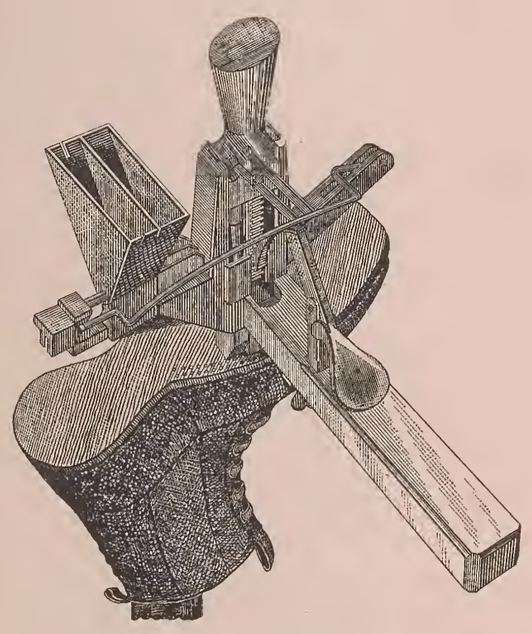
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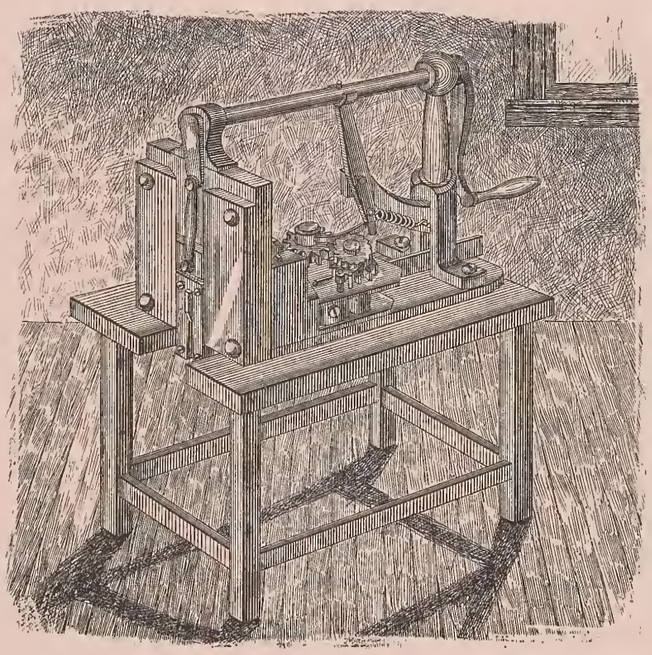
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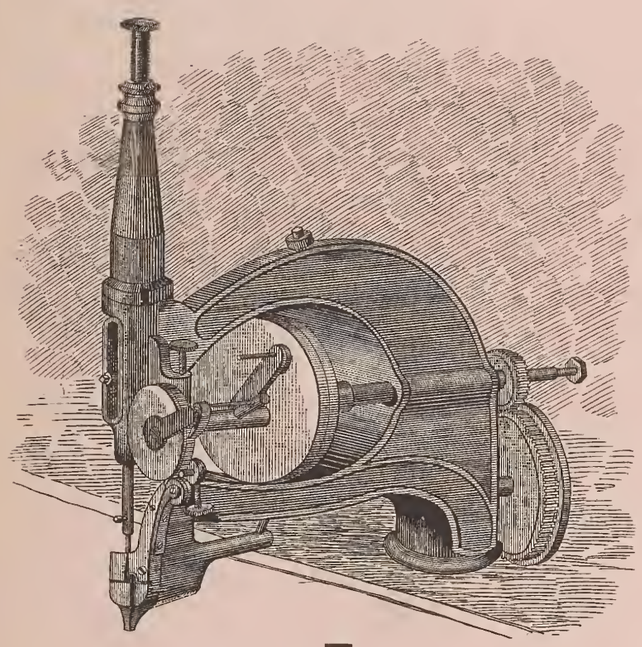
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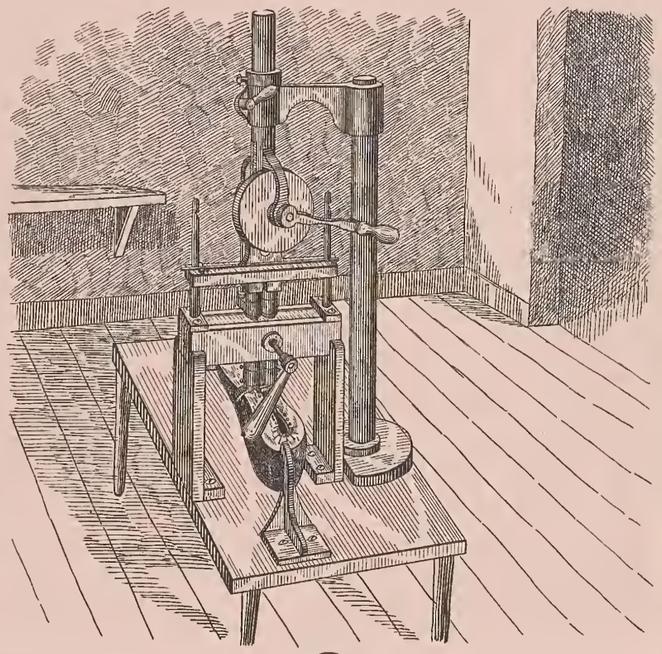
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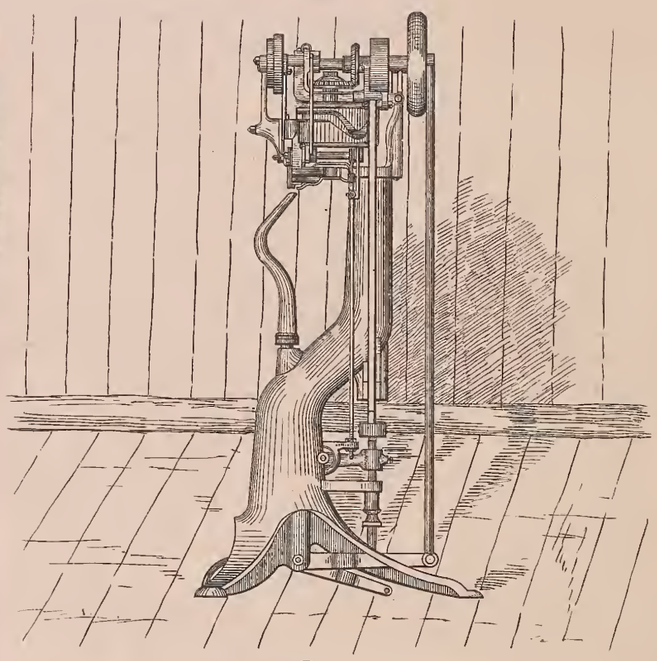
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9

BOOT AND SHOE NAILING AND PEGGING.

BOOT & SHOE NAILING & PEGGING MACHINES.

No. 1. Egyptian Cobbling.
2. French " —A D. 1775.
3. U. S. Patent, Hand Nailing—A. D. 1812.
4. " " " Pegging—A. D. 1849.
5. " " " Stapling—A. D. 1860.
6. " " " Nailing—A. D. 1862.
7. " " " Pegging—A. D. 1868.
8. " " " " —A. D. 1872.
9. " " " Wire Nailing—A. D. 1879

Boots and shoes were all made by hand prior to 1800. In 1810 Brunel invented the first machine for making shoes; his invention never came into general use, as it increased instead of decreased the cost of manufacture; it is also stated that the shoes did not answer, as the nails penetrated the soles and hurt the feet of the wearer.

The first patent in the United States for a machine for pegging shoes was obtained by Samuel Hitchcock and John Bement, of Homer, N. Y., July 30, 1811.

Joseph Walker obtained his patent for shoe pegs in 1818. This wrought quite a revolution in the shoe business.

The tradition is current in New England that at one time shoe pegs became so plenty and cheap that artful speculators tried to sell them to farmers as a new variety of oats for seed.

The pegging machines of Gallahue, 1851, and improvements of Townsend and Sturtevant, were not brought into general use until 1860. The sole sewing machine of Blake, improved by McKay, and the Goodyear welt machine have, with the pegging machine, revolutionized shoe manufacturing.

The boot and shoe cable screw wire machine, which uses a flexible wire twisted in the form of a screw, which is cut off in proper lengths and driven into the sole, is capable of putting on 500 pairs of soles in a day.

Wooden boot and shoe pegs are made of maple wood by a machine which cuts the wood into ribbons of the thickness required, and then forms and points the pegs, leaving them attached at the top by a slight connection which forms the head of the peg when detached.

At the present time the shoe trade is almost entirely supplied with machine work.

BOOT & SHOE NAILING & PEGGING MACHINES.

18,369 Manufactories in the United States.

	1860	1880
Capital Invested,	$23,357,627.00	$58,973,665.00
Value of Productions,	91,889,298.00	217,093,627.00
Wages Paid,	30,938,080.00	53,820,864.00
Hands Employed,	123,026	143,201

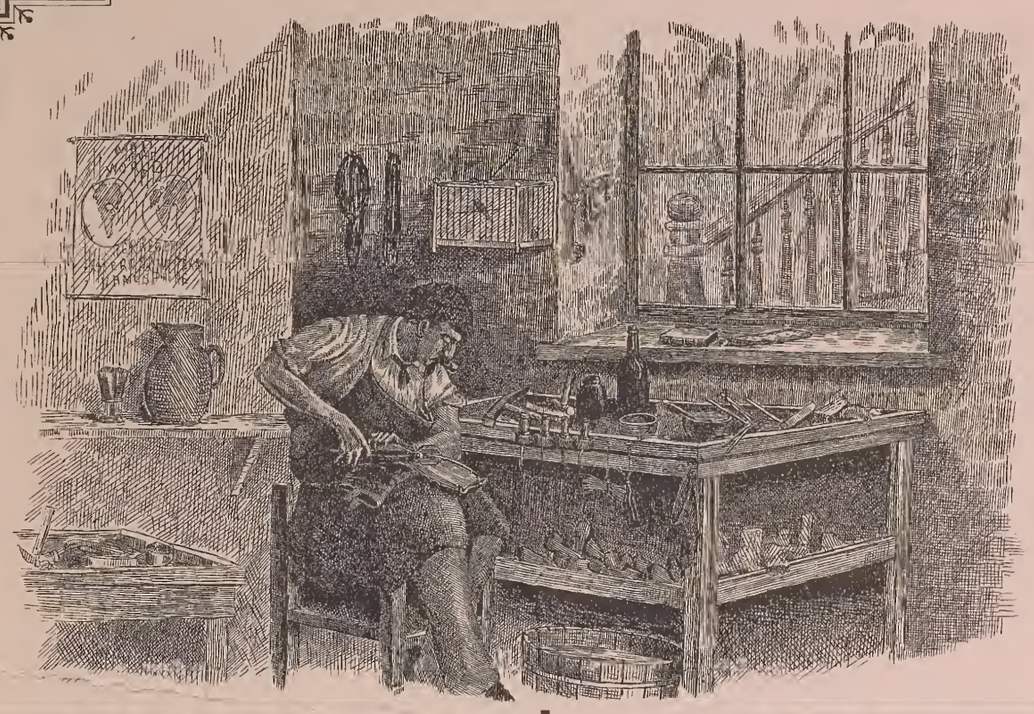
Manufactured in 1880.

Boots, prs.	Value.	Shoes, prs.	Value.
30,590,896	$53,223,265.00	94,887,615	$112,109,343.00

Capacity—	Primitive Meds.	Present Machns.
Pairs per day,	40	750
Hands Employed per day,	1½	1½

572 Patents Granted by the United States.

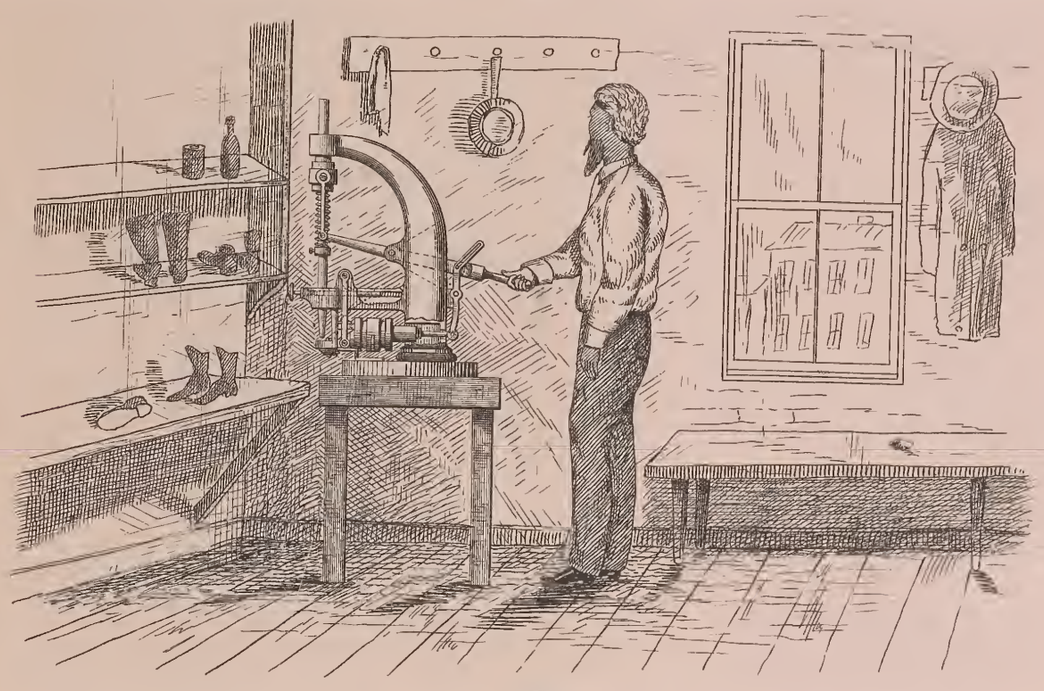
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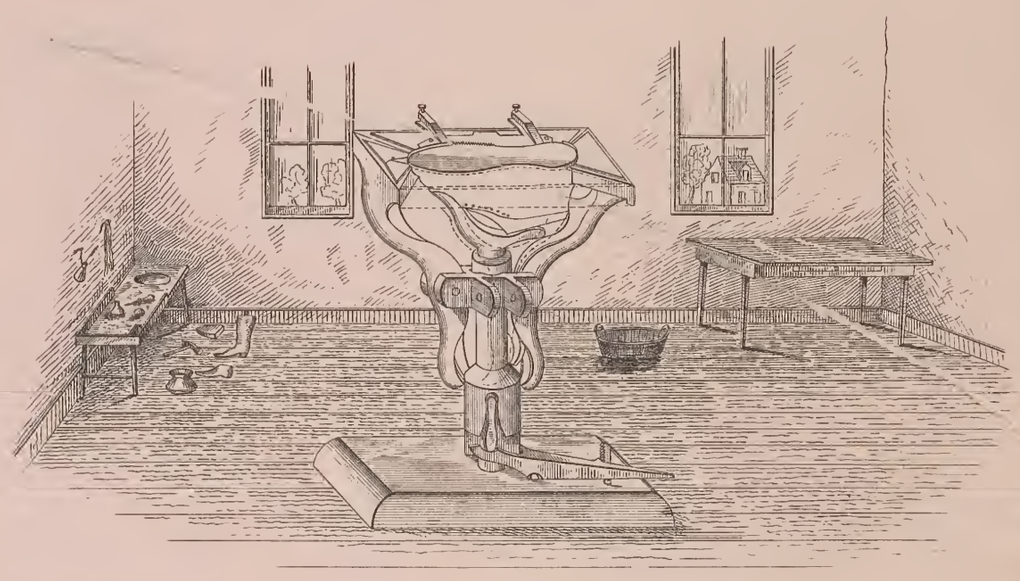
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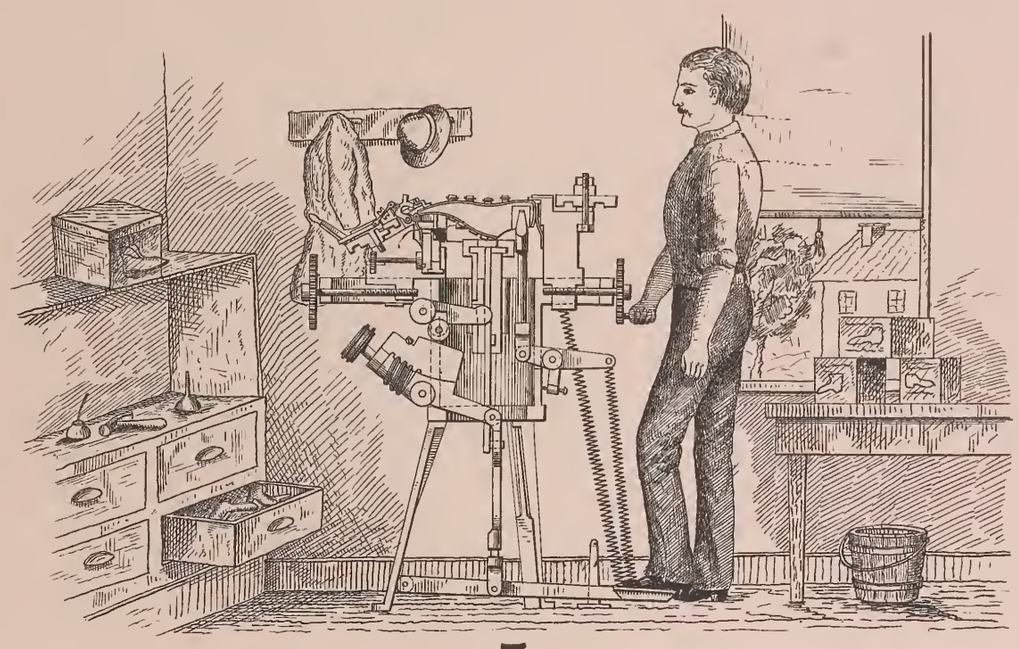
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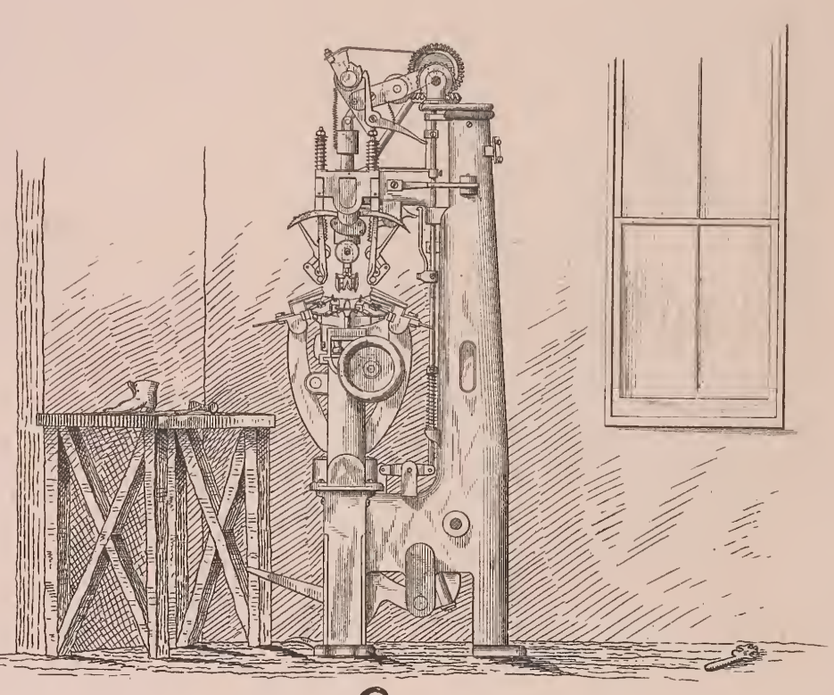
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BOOT AND SHOE LASTING.

BOOT AND SHOE LASTING MACHINES.

No. 1. Primitive Hand Implement.
2. U. S. Patent, Leather Stretcher—A. D. 1845.
3. " " Lasting Machine—A. D. 1859.
4. " " Magnetic Tacker—A. D. 1876.
5. " " Automatic Lasting Machine—A. D. 1878.
6. " " Lasting Machine—A. D. 1880.

Lasts are mentioned by Greek authors.

The term "last" comes to us from the Anglo-Saxon "laest," which was allied with the same word, meaning a track, or footstep, and from the original of which is derived the Icelandic word "lyste," a shoe.

Right and left lasts were introduced into England about 1785.

In the various fashions for shoes which have arisen since their introduction, the lasts upon which they were made have varied with them.

The style and fashion of the shoe depend chiefly upon the shape and form of the last.

Lasts are generally made of rock or hard maple wood.

A cord of wood will make on the average about 500 pairs of lasts.

Lasts and boot trees take 500,000 cords of beech, birch and maple annually in the United States.

BOOT AND SHOE LASTING MACHINES.

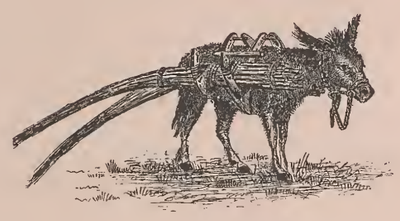
18,369 Manufactories of Boots and Shoes in the United States.

	1860	1880
Capital Invested,	$23,357,627.00	$58,973,665.00
Value of Productions,	91,889,298.00	217,093,627.00
Wages Paid,	30,938,089.00	53,820,864.00
Hands Employed,	123,026	143,201

Capacity—	Primitive Mode.	Present Machine.
Pairs per day,	120	300
Hands Employed per day,	2	2

108 Patents Granted by the United States.

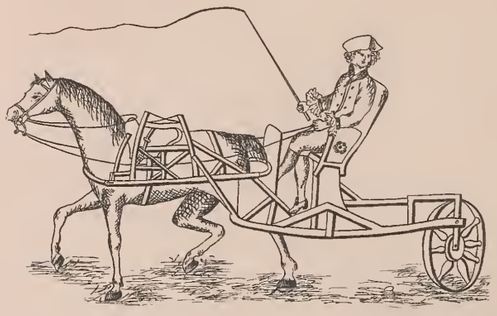
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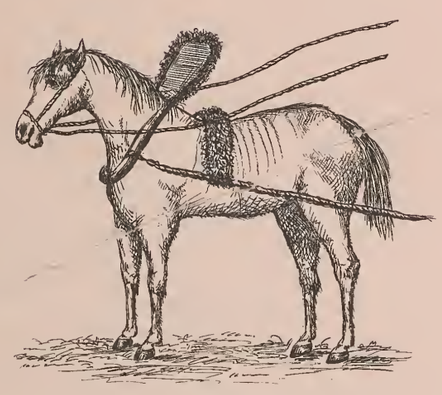
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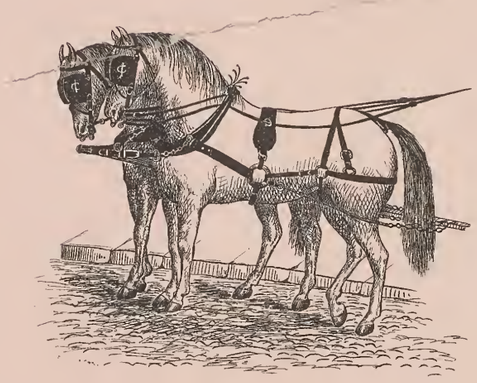
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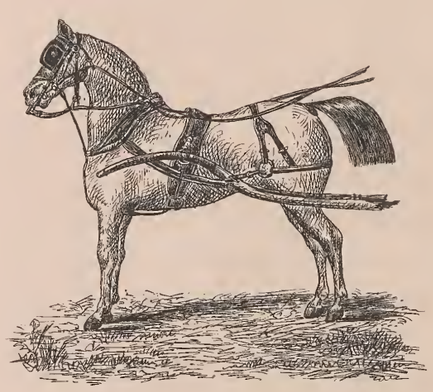
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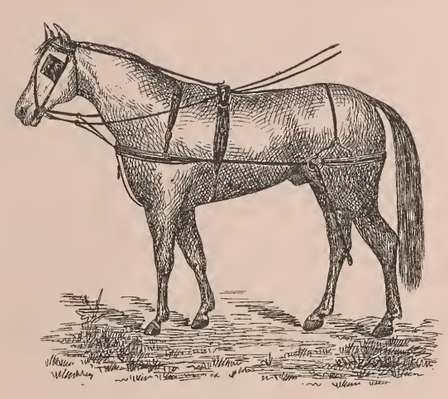
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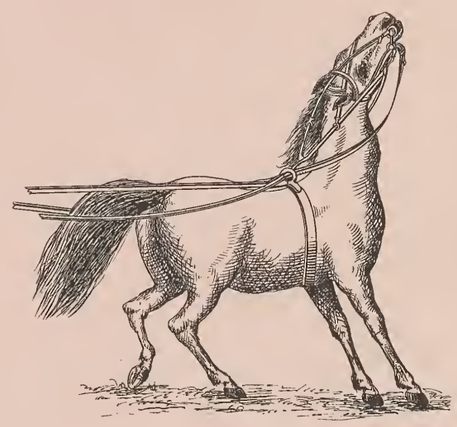
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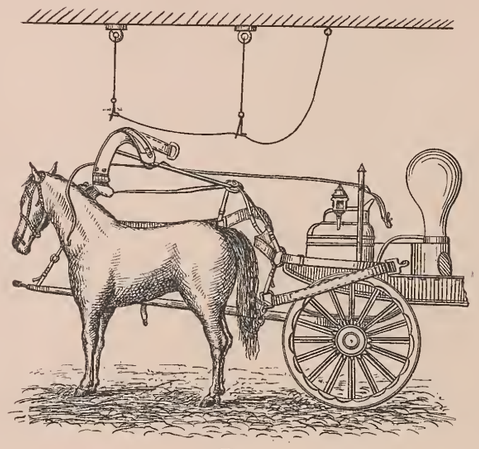
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HARNESS.

HARNESS.

No. 1. Ancient Pack Saddle.
2. English—16th Century.
3. " —A. D. 1750.
4. Rope.
5. Heavy Draft.
6. Coupè, Single.
7. Breast Collar, Single.
8. U. S. Patent, Overdraw Check—A. D. 1866.
9. " " Suspended—A. D. 1876.

The invention of harness is ascribed to Erichthonius, of Athens.

The use of harness commenced as soon as the horse was trained to draft.

The first horsemen, not being acquainted with the art of governing horses, managed them with a switch, assisted with the accent of the voice.

That shown in the sculptures of Egypt was of a very simple construction. The horses were hitched abreast to a tongue or pole, which was connected to a yoke; this passed over saddles which rested on the withers of the horse.

Solomon had 40,000 stalls for horses and chariots, and plenty of harness.

While the Egyptian yoked his horses to the pole of his chariot, still more primitive customs were adopted in other lands at a later date.

The ancients were well acquainted with the use of the bit. Xenophon, 400 years B. C., describes bits as being in common use in his time in the Grecian States. He speaks of a smooth and sharp kind; the latter, if more severity was required, was to be armed with points or teeth.

In the sculptured equestrian figures of the ancients, something like the branches of a curb are to be found, but in no instance does there appear anything resembling the chain which is necessary to its effect.

The addition of the chain to curb bits is of modern invention. It was used in Italy and France, and was introduced into the English army by proclamation in the reign of Charles I.

"The Spaniards outwitted the French in lining their harness with chains, so that it could not be cut." (Pepys, 1661.)

The French still make use of rope harness, and frequently have nine horses to a diligence, which are driven three abreast.

The single line mode of driving horses, usual on farms and with heavy road teams throughout the west, was made very familiar to many during the late war. The Government six-mule teams are driven by a man riding the near wheel horse, and having a single line to a bridle rein on the near leader. The bit of the off leader is connected by a jockey stick to a hame ring of the near leader, which keeps him in place. The off wheeler is governed by the whip, foot, or occasional touch of his rein. This mode of driving is also practiced in the Netherlands.

Besides the kinds of harness depending upon quality and mounting, other varieties are known by the names of buggy, coach, cart or wagon, according to the vehicle used, and the latter have a division into lead, hip, strap breeching and Yankee, according to the construction and arrangement.

The use of devices for detaching and adjusting harness to horses in the steam fire departments of large cities has become an important factor in the time saved in attending fires.

HARNESS.

7,999 Establishments in the United States.

	1860	1880
Capital Invested, - -	$6,478,184.00	$16,508,079.00
Value of Productions, - -	14,169,037.00	38,081,643.00
Wages Paid, - - -	4,150,365.00	7,997,752.00
Hands Employed, - - - -	12,285	21,446

2,543 Patents Granted by the United States.

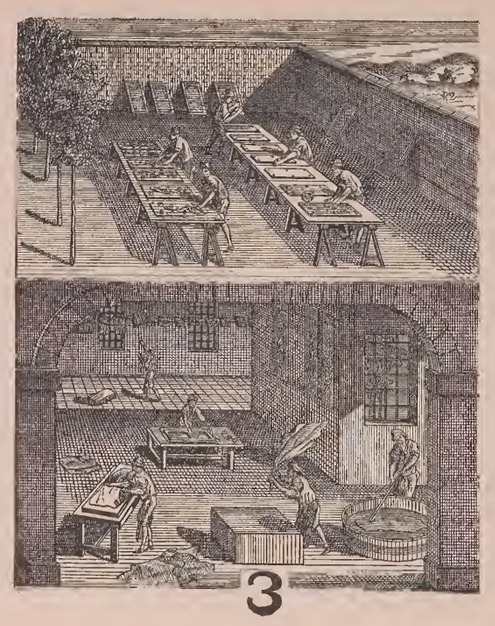
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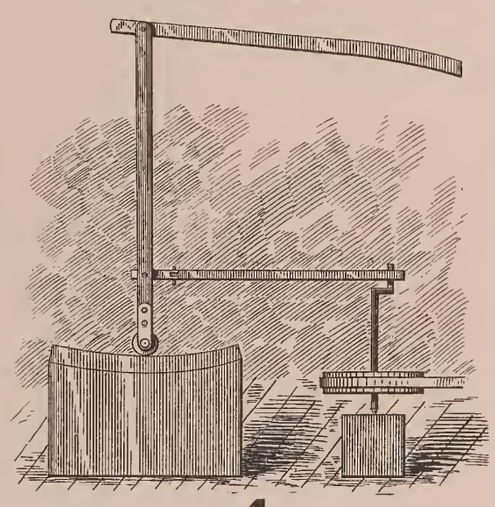
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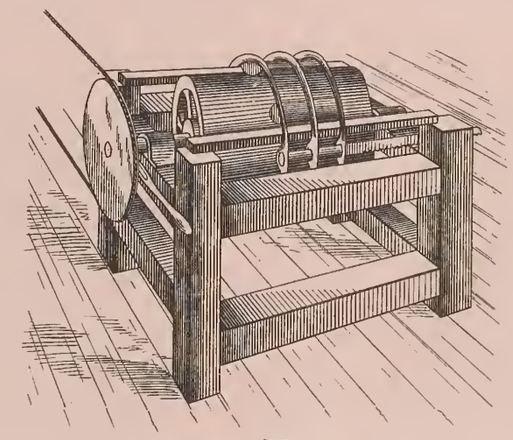
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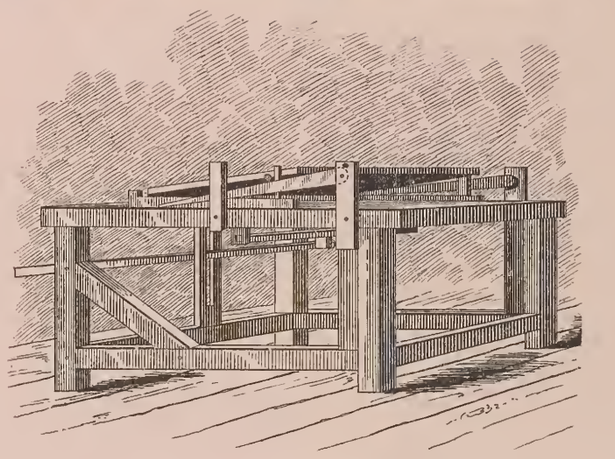
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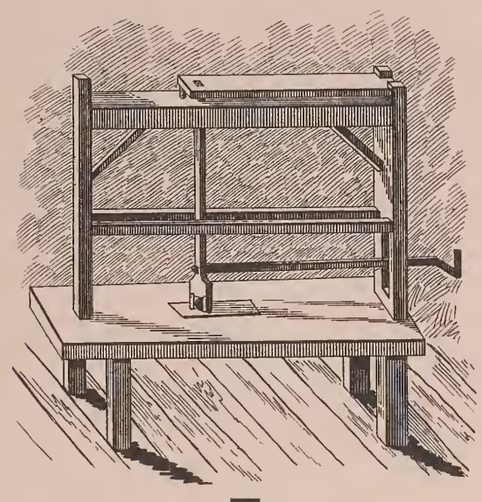
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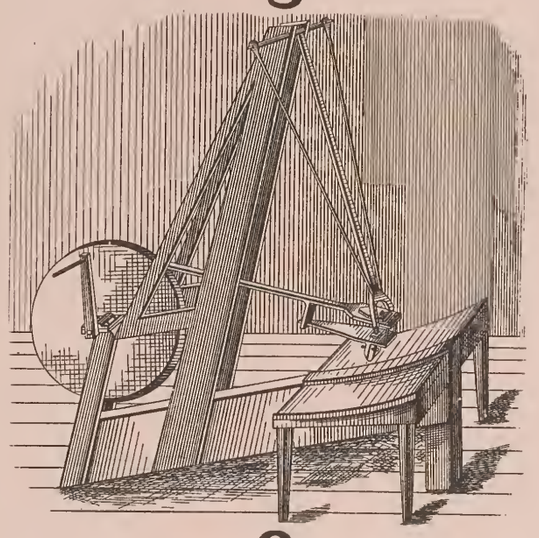
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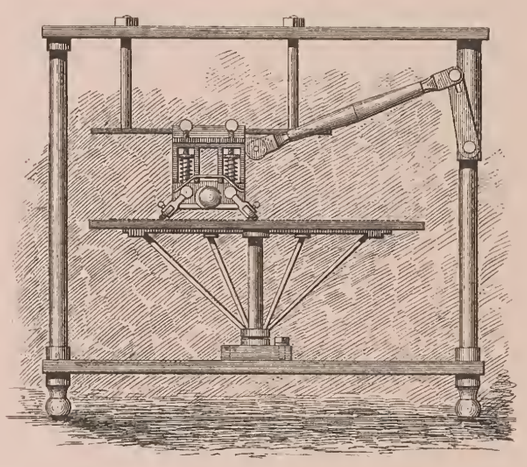
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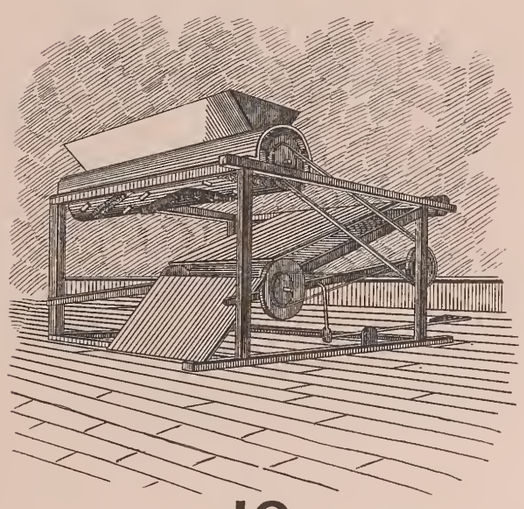
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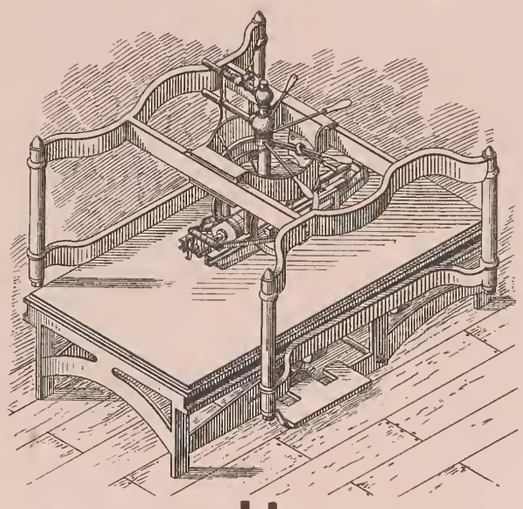
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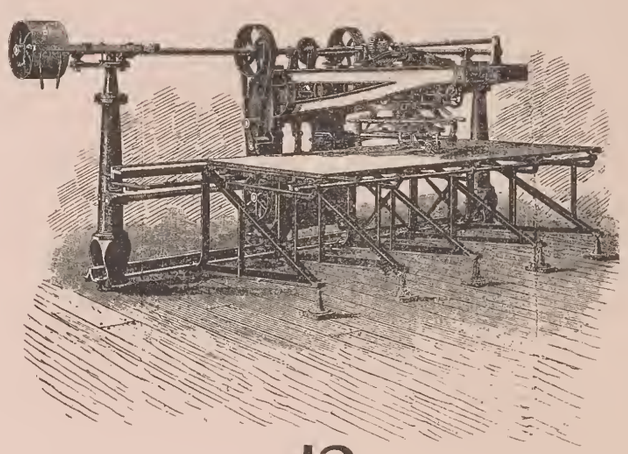
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11



12

LEATHER WORKING.

LEATHER WORKING.

1. Primitive Hand.
2. " Hungarian—A. D. 1550.
3. " French—A. D. 1775.
4. U. S. Patent, Roller Dressing—A. D. 1812.
5. " " Dressing—A. D. 1827.
6. " " " —A. D. 1835.
7. " " " —A. D. 1836.
8. " " " —A. D. 1855.
9. " " Scouring and Setting—A. D. 1857.
10. " " " " Stretching—A. D. 1871.
11. " " Working Hides and Leather—A. D. 1874.
12. " " Scouring, Setting and Glassing—A. D. 1882.

The mode of currying skins upon a slanting beam is shown in the ancient paintings of Kourna Thebes. Slicking with a sharp edge is also shown. The paintings and sculptures of Thebes represent many of the methods of working leather practiced by these people as very similar to those of the present time. Figures of men are seen currying, stretching and working it. No accounts are preserved of the methods of preparing the leather used by the Romans.

We read that the outer coverings of the Tabernacle were made of rams' skins, and the circumstance of their being dyed red leads to the conclusion that they must have been prepared by tanning or other process previous to that operation.

The origin of tanning is unknown, although it must have been known at a very early period by the Eastern nations.

The Britons exported skins in early times, but afterwards learned the art of tanning, and carried it on in establishments of great extent on the banks of streams.

The dressing and working of leather in Japan and India are considered the most degrading of all pursuits, and the class that practice them is tabooed.

In North and South America the natives prepare leather by methods of their own.

Morocco leather of fair quality was made in Charlestown, Mass., in 1770.

The first manufacture of Morocco leather in the United States was started at Lynn, Mass.

Bronze leather slices, similar to those of the ancient Egyptians, has been found in old Mexican sepulchres, indicating that the art of making and using leather was understood by the inhabitants of that country.

Liverpool is the principal trade market of England, and there most of the imports of hides from South America arrive.

The tanning of alligator skins was commenced about 1855, some 17,000 to 20,000 are now tanned yearly, and are consumed by boot and shoe manufacturers in the United States.

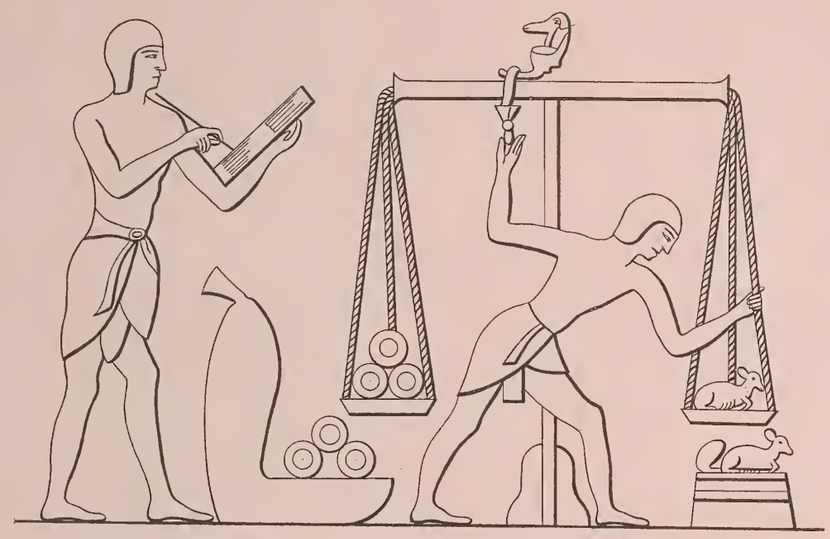
The principal mechanical appliances used in the manufacture of leather are for softening, pulling, rolling and splitting, washing, glazing, finishing, sweating, &c.

The process of splitting hides is a very ingenious method for reducing the hide to a uniform thickness throughout. It is done by machinery, and the operation is quickly performed—a large hide being split in two in less than five minutes. This is accomplished by means of an oscillating knife driven by steam, as the power which divides the skin in two portions. The grain side hide so split is known in the trade as a split hide, the flesh side as splits.

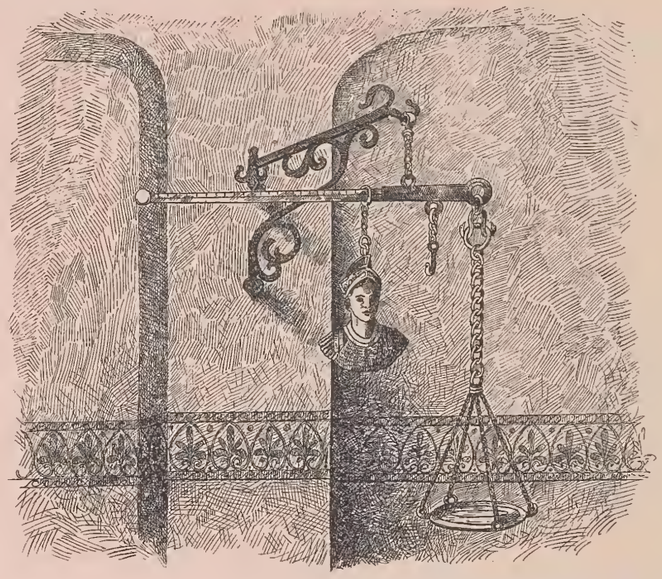
LEATHER WORKING.

345 Patents Granted by the United States.

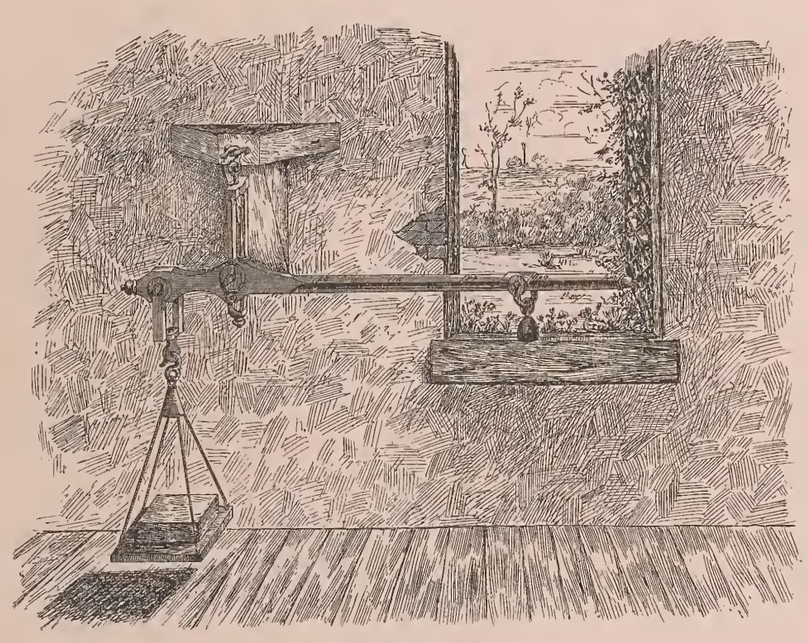
Sackett & Wilhelms Litho Co New York



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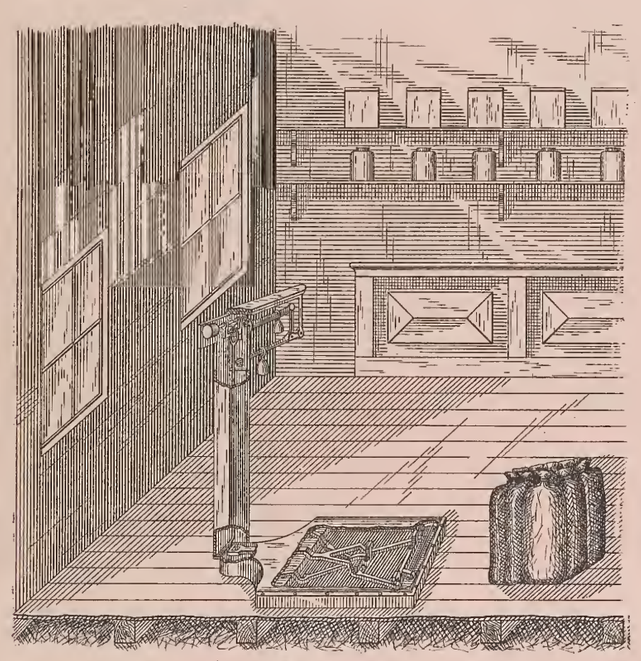
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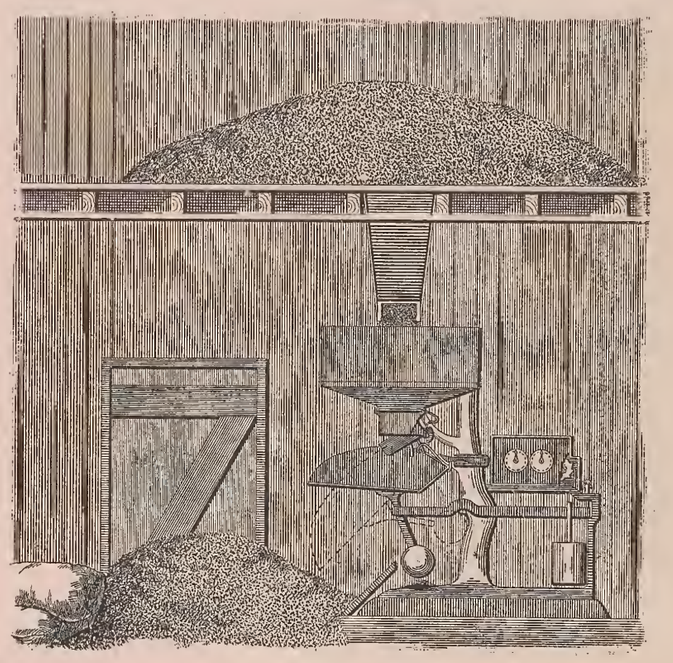
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6

BALANCES.

BALANCES.

1. Egyptian.
2. Roman.
3. Medieval.
4. U. S. Patent, Steelyard—A. D. 1819.
5. " " Platform Scale—A. D. 1838.
6. " " Automatic Grain Weigher & Register—A. D. 1880.

The art of weighing is as old as the time when trading ceased to be mere barter. Before the coinage of money, bullion was weighed out in payment for merchandise. Coinage was simply the production of pieces of precious metal having their weight guaranteed. Scales for this primitive purpose were of the simplest form, consisting of a bar pivoted at its middle and having a pan at each end, as in an apothecary's scales, the weight employed and the material being put in opposite pans and made to balance each other.

This form of balance, answering every purpose to weigh such materials as the precious metals, the quantities of which were small, was inconvenient when materials in large quantities were to be weighed, Hence, at a very early period, the form was modified to one nearly the same as that of the modern steelyard, which involves the well known principle of the lever, that the power and weight are to each other inversely as their respective arms. By this means a large quantity of material can be weighed with a comparatively light poise. This form of balance is found among the Egyptian inscriptions. Its French name, "romaine," indicates the source whence it came to modern Europe.

There is no device in so general use and for so long a period in which invention has been so sluggish, and with the exception of the knife-edge pivots, the steelyards in use at the beginning of the present century did not differ materially from those used in Rome and Pompeii.

The earliest American patents for improvements in weighing instruments were granted to Benj. Dearhorn in 1819. The improvements consisted in means for facilitating the handling of the instrument and of the heavy bodies to be weighed, but in one particular only were directed towards improving the delicacy and accuracy of the instrument itself. This was by bending upward the shorter end of the beam, and so raising the center of gravity higher with respect to the pivots.

The earliest attempt at what is now called the platform scale appears to have been made in France in 1822. Rude forms also appear in British patents of the same period. But there is no evidence that any success followed these efforts. It was not until Thaddeus Fairbanks, of Vermont, U. S. A., led by the desire of some means to readily weigh large quantities of hemp straw, devised a successful platform scale of the capacity of a ton, that the value of this invention was realized. A demand quickly followed for scales of similar pattern and of all sizes, from the lightest counter scales to vast canal weigh locks of hundreds of tons capacity; and for the ordinary purposes of commerce scales of this form quickly usurped the place of all others, the world over. This may be classed among leading American inventions, and the manufacture a distinctive American industry.

The vast development of the grain production of our Western country, and the necessity of rapid handling in conveying grain to the Eastern and European markets, have led, within a few years, to the introduction of automatic weighing machines or "grain meters." The grain in going through the elevator, or at some stage, passes into a weighing hopper; when the hopper is filled, and depressed by overcoming the weight on the beam, it automatically cuts off the inflowing stream and opens the discharge valves, and when the load is dumped rises again, the discharge valves close, and the gates for the admission of grain are again opened. This process is repeated indefinitely. The forms of this machine are very numerous.

Recent improvements in weighing machinery, which promise success, involve increasing their delicacy by the substitution of other forms of pivots for the knife edges, such as flexible steel or torsion wires. Machines of this character show great capacity, combined with extreme delicacy and accuracy; but they have not yet come into general use.

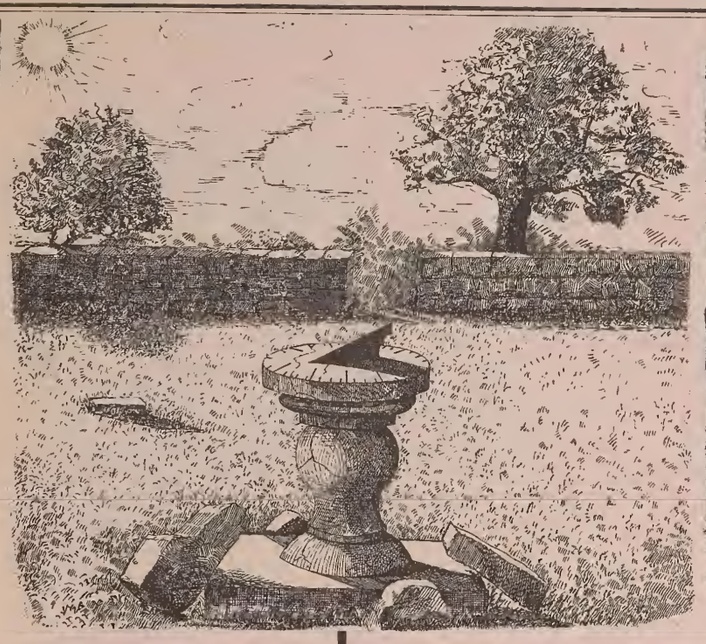
BALANCES.

64 Manufactories of Scales and Balances in the United States.

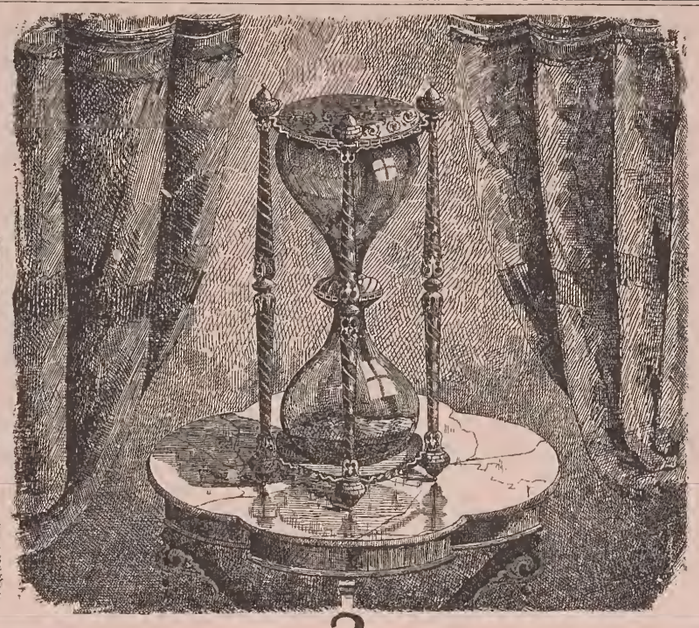
	1860	1880
Capital Invested,	$744,300.00	$3,814,981.00
Value of Productions,	1,292,560.00	3,252,460.00
Wages Paid,	280,015.00	783,019.00
Hands Employed,	725	1,554

839 Patents Granted by the United States.

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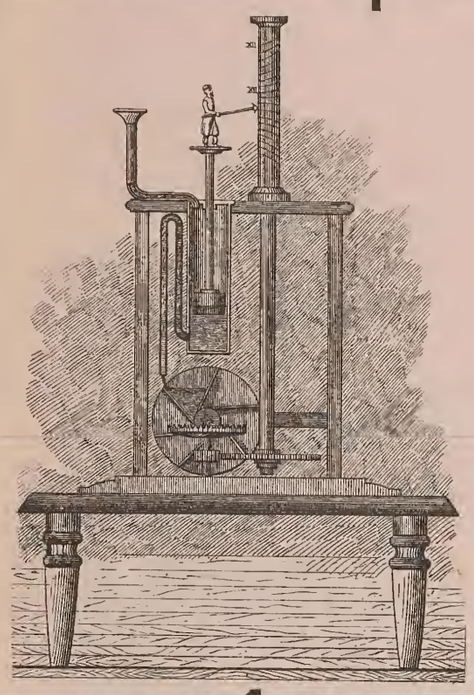
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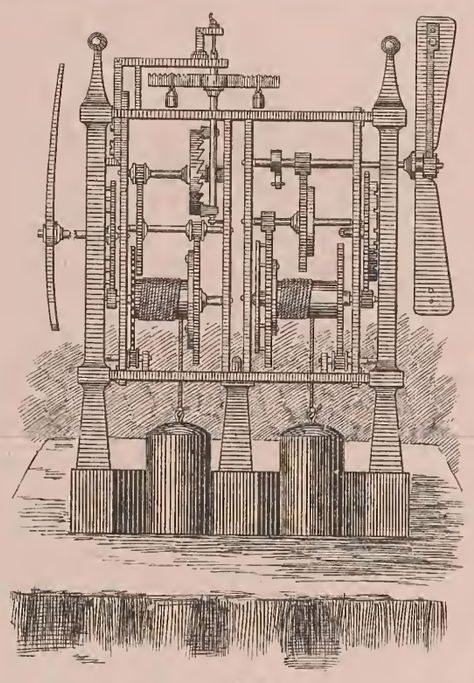
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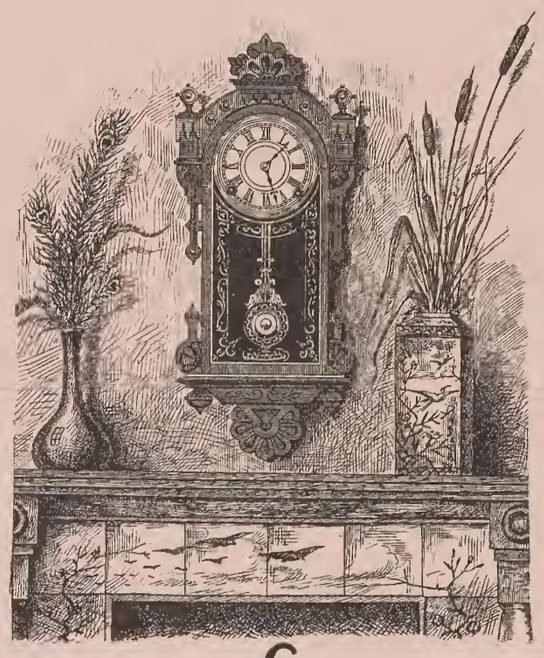
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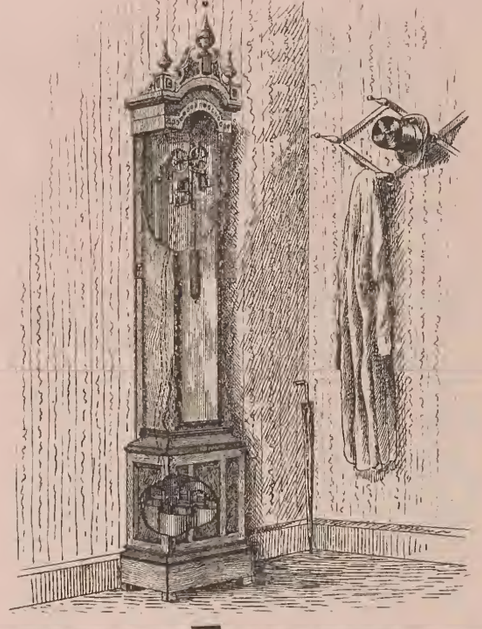
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8
HOROLOGY.

HOROLOGY.

No. 1. Primitive Sun Dial.
2. " Hour Glass.
3. " Floating Bowl of the Brahmins.
4. Clepsydra of Ctesibius—B. C. 245.
5. French, De Wick's Clock—A. D. 1370.
6. Eight-day American Clock.
7. U. S. Patent, Independent Electric Clock—A. D. 1882.
8. United States. Railway Standard Time.

The earliest means of noting the passage of time was by observation of the heavenly bodies. Sunrise and sunset were the most conspicuous events, and formed natural divisions of the day. Noon, or the period when the sun ceased to rise, and began its descent, was naturally the period next observed.

Time was noted by observation, first of the sun itself, then of shadows. This led to the construction of the sun dial, which was at first a mere upright post or staff, but of which many forms were invented later.

The earliest time keeper requiring mechanism of any character was the clepsydra, which, in its primitive form, was a vessel having a small orifice through which water was permitted to flow by drops. The quantity passing through was indicated, perhaps, by graduations on the receiving vessel. This was in use in Assyria, and may have been an invention of the Chaldeans. The Hindoo device of a perforated bowl, into which water enters from a filled vessel in which it floats, is a form of clepsydra. The sand glass is a later invention.

The improvement of the clepsydra by the addition of wheels and a dial with a pointer, is at least as old as Ctesibius, about 245 B. C. Various devices were employed in connection with it for sounding the hours. The simpler form was used in the courts of Athens and Rome to regulate the time of speakers.

Another primitive device for indicating time was the graduated candle used by King Alfred. To this were sometimes attached little balls of metal, which dropped as the candle was burned away, and by falling in a metal vessel gave an audible indication.

The clock was a development from the improved form of clepsydra. In some of these a weight furnished the actual motive power, the water being used to regulate its descent. But no mechanical clock was practicable until the system was adopted of marking time by equal divisions, instead of the Roman system, under which the day and the night, whatever their length, were each divided into twelve equal spaces, called hours.

The invention of the clock has been attributed by various writers to inventors of the 5th, 9th, 10th, 11th and 14th centuries. The system of unequal hours was in use, however, as late as the 11th, and it may therefore be doubtful whether any of the so-called clocks of earlier centuries were truly such.

It is probable clocks were actually first invented by the Saracens, and made their first appearance in Europe in the convents, the only places where the conditions were favorable to their introduction.

The first clock publicly erected in Europe was built by Dendi, at Padua, in the 14th century. Nothing is known of its structure.

The earliest clock of which we have any authentic description was built by Henry De Wick, for Charles V, of France, in 1339. It had a dial and a single hand, and struck the hours. Except the escapements, it was in all respects like a modern Dutch clock.

The spiral spring was invented about 1460.

The discovery of America by Columbus, in 1492, and the great impetus given to navigation, showed the necessity for some means of determining the longitude at sea.

Gemma Frisius, a Dutch astronomer, was the first to suggest the use of accurate time keepers for the purpose. So important was this problem that large rewards were offered by the Spanish and British Governments for its successful solution.

The application of the pendulum to the regulation of a clock was first suggested by Galileo. It is in dispute by whom this was first accomplished, but the earliest date given for it is 1641.

The 17th century was prolific in improvements in clocks.

Hooke invented the anchor escapement; Huyghens the cyclerdal pendulum dial train, maintaining power, and spiral balance spring.

Near the close of the century, John Harrison invented the marine chronometer, for which he received the British reward of £20,000.

These inventions being in the line of improving the clock in exactness, it was reserved for American inventors to make the improvements which should render its use universal and indispensable. The introduction of American brass clocks put a fairly reliable time keeper within the reach of everyone, and they are known and used everywhere on the globe.

The application of electricity to clocks was first attempted in England, by Bain, in 1841. Since that time many improvements have been made in this direction. Electricity is employed as a motive power for individual clocks, but more commonly clocks, each actuated in the usual way by a weight or spring, are connected with a central regulator so as to be wound, controlled, or set at stated times.

Many of the patented systems propose to "synchronize" clocks at distant points through the wires of telegraph or telephone lines, without interfering with their ordinary uses.

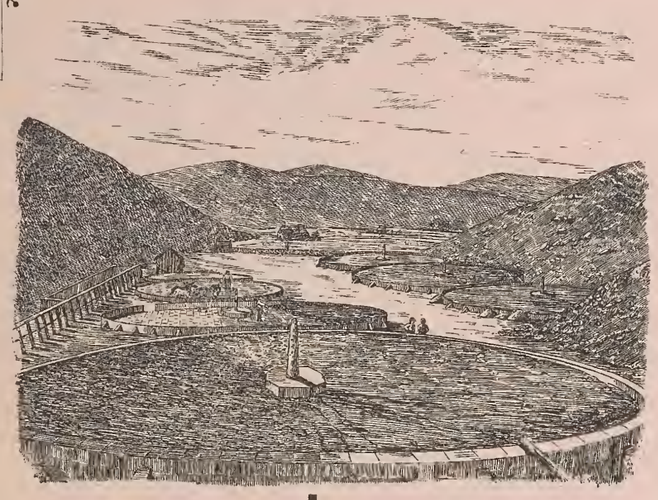
HOROLOGY.

82 Manufactories of Watches, Watch Cases, Clocks and Clock Cases in the United States.

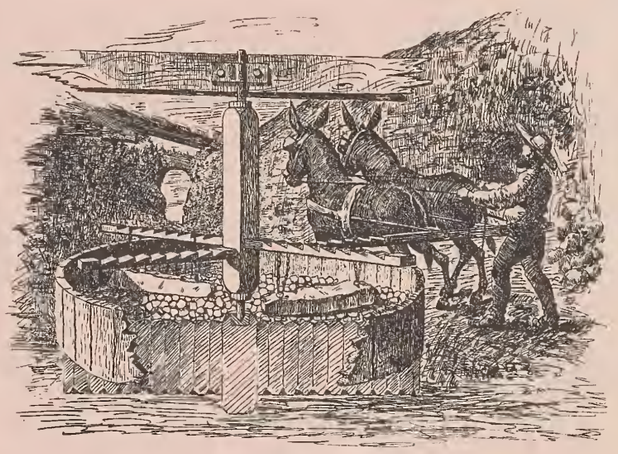
	1860	1880
Capital Invested, -	$1,364,211.00	$8,327,517.00
Value of Productions,	2,758,750.00	12,321,520.00
Wages Paid, - -	765,420.00	4,412,060.00
Hands Employed, - -	1,834	9,168

1,868 Patents Granted by the United States.

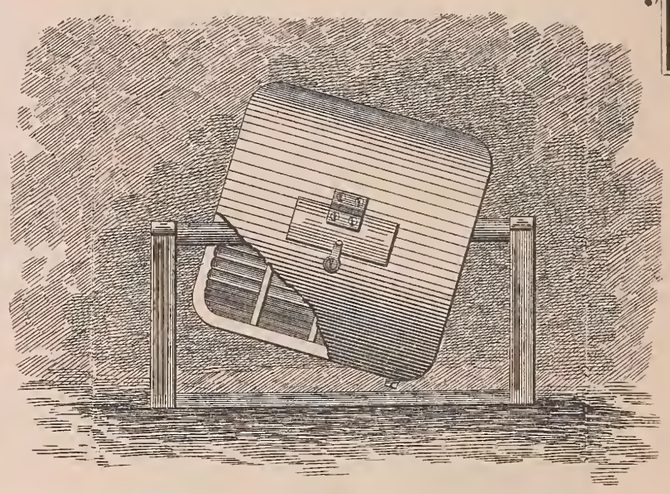
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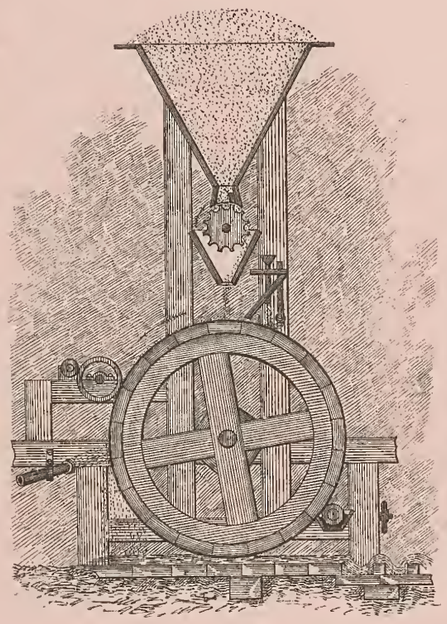
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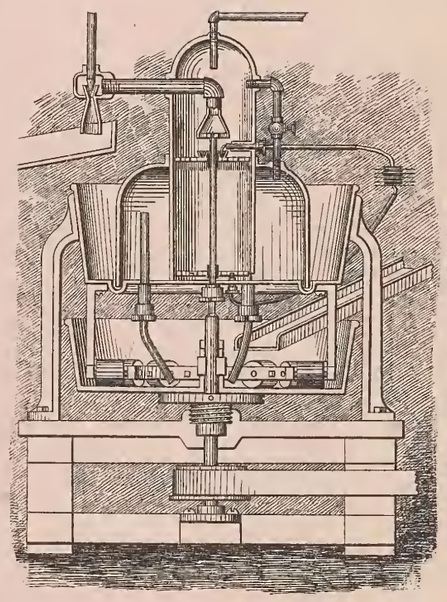
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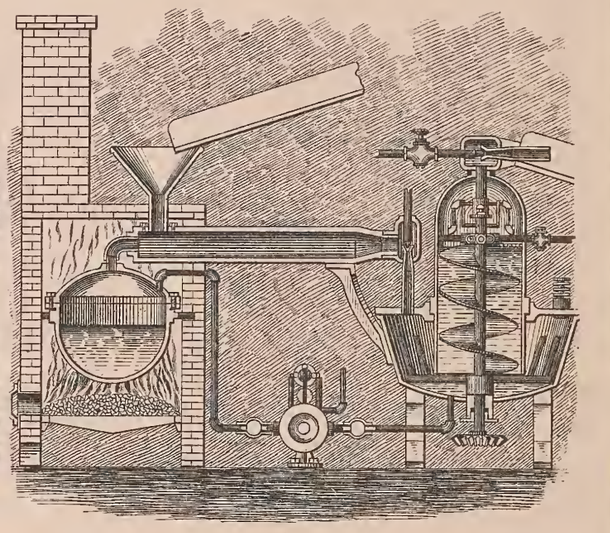
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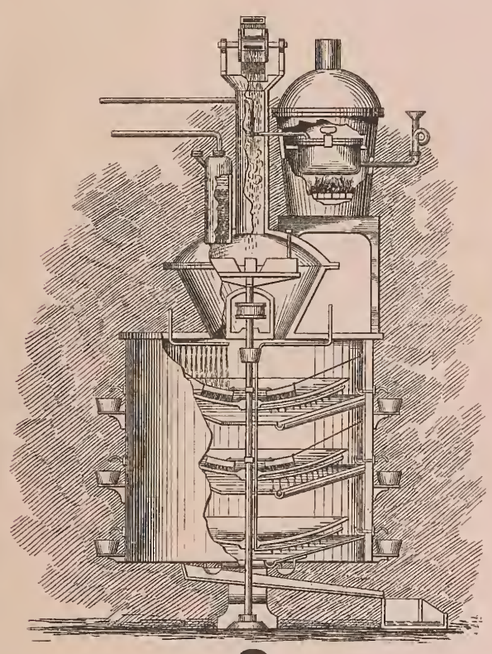
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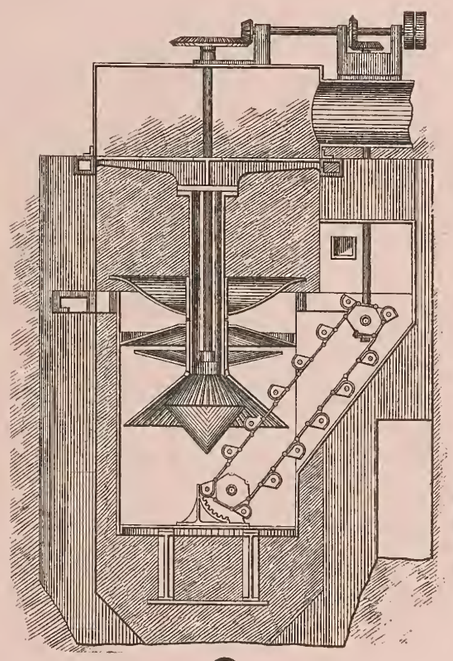
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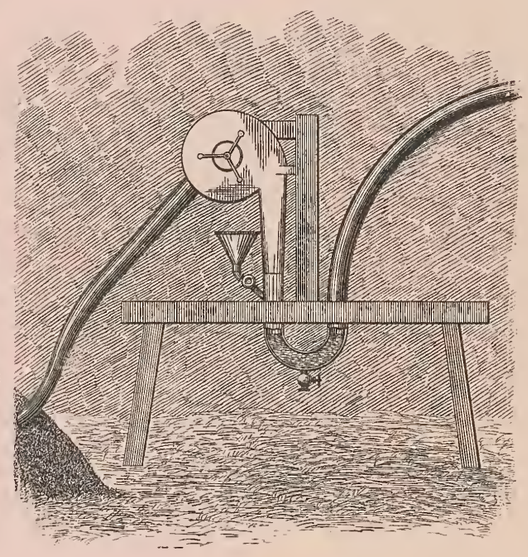
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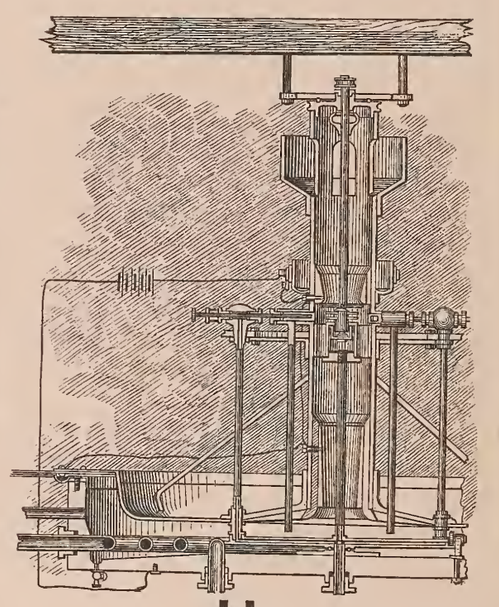
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11

AMALGAMATORS.

AMALGAMATORS.

1. Primitive Patio.
2. " Arrastra.
8. U. S. Patent, Barrel Amalgamator—A. D. 1868.
4. " " Mercury Amalgamator—A. D. 1877.
5. " " Cylinder Plate Amalgamator—A. D. 1881.
6. " " Electric and Vacuum Amalgamator—A. D. 1881.
7. " " Mercury Vapor and Vacuum Amalgamator—A. D. 1882.
8. " " Mercury Vapor and Plate Amalgamator—A. D. 1888.
9. " " Lead Amalgamator—A. D. 1883.
10. " " Pneumatic Amalgamator—A. D. 1888.
11. " " Electric Amalgamator—A. D. 1884.

The knowledge of the solvent power which mercury exercises over various metals was not only known by the ancients, but was employed by them in the separation of gold from the baser metals and in the gilding of silver.

Vitrurius, 27 B. C., describes the manner of recovering gold from cloth in which it was interwoven. The cloth was first put in an earthen vessel and placed over fire, that it might be burnt; the ashes were thrown into water, and quicksilver added—the latter uniting with the gold—and the water poured off, the cloth squeezed with the hands. The quicksilver oozed through the cloth, leaving the gold pure and in a compressed mass.

The Patio process, which was invented in 1557, has long been used in South America and is still in use in Mexico and parts of the United States.

Mercury was first applied to the extraction of silver, from the ores of Peru and Mexico, by Fernandez de Valesco, in 1571.

Hanks, A. D. 1572, says that, "the process of amalgamating silver ores with mercury is being substituted for melted lead."

The first use of quicksilver for amalgamating purposes is considered a Spanish invention, discovered about the 16th century.

The open process is designed especially for operation upon ores of poor quality.

The barrel process was in use in the latter part of the last century in Germany.

The Estupa process is a modification of the Patio, and is employed in some districts of Mexico.

The Caco process, used in Mexico and Chili, is a hot amalgamation in kettles. This process is employed on a class of ores containing large proportions of native silver.

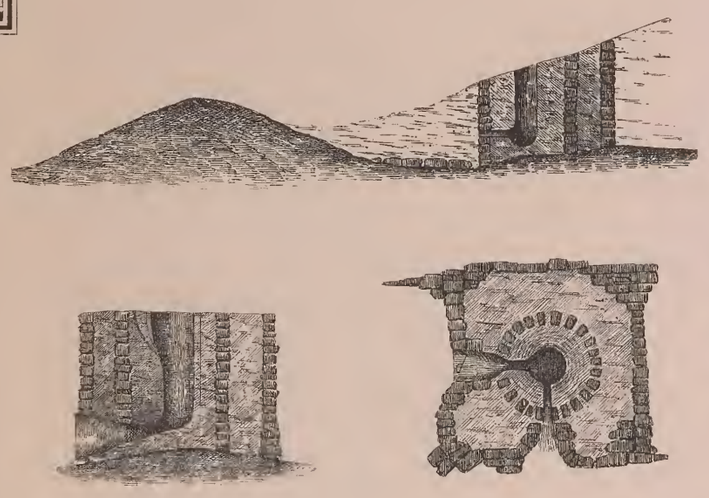
Varney, in 1852, invented a strainer for expediting the straining of amalgam.

Ore, after being pounded and mashed, is combined with quicksilver, by which an alloy or amalgam is formed. This, after removing the more earthy parts, is enclosed in leather and subjected to pressure, by means of which the more liquid parts are forced through the leather, while the residuum, containing the greater part of the gold, remains. It is then subjected to distillation, in order to separate the quicksilver. In other cases the metal is purified by liquefying it with some other metals of different specific gravity, or is subjected to the action of acids, or to other processes, according to the nature of the metal, and also of the substances with which it is found combined.

AMALGAMATORS.

492 Patents Granted by the United States.

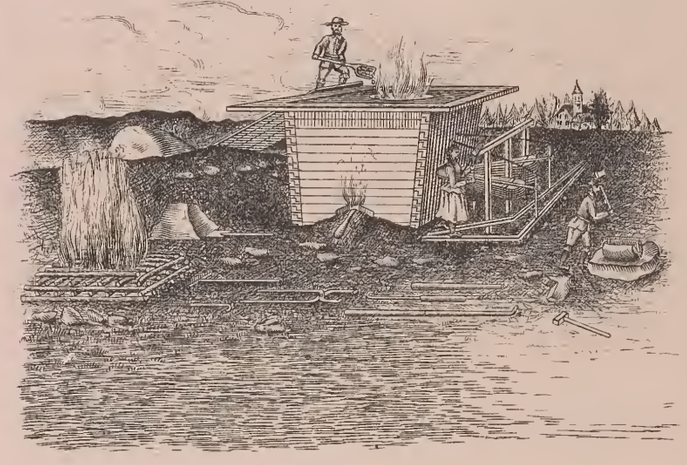
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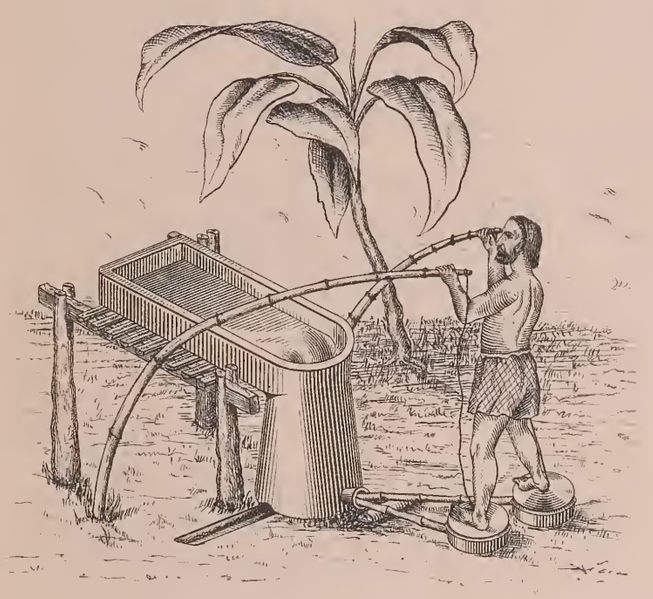
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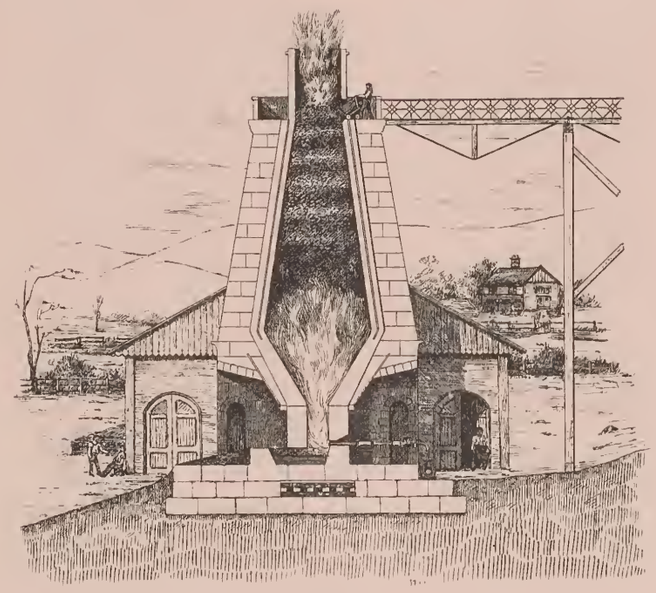
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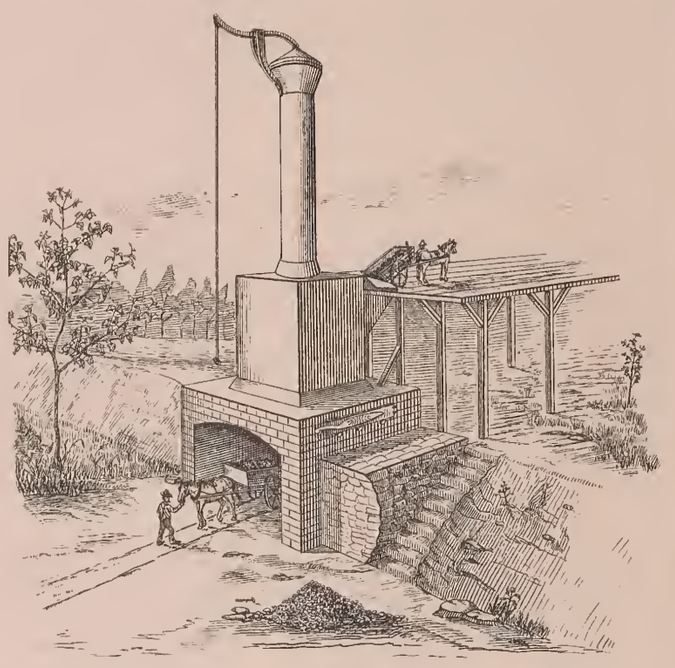
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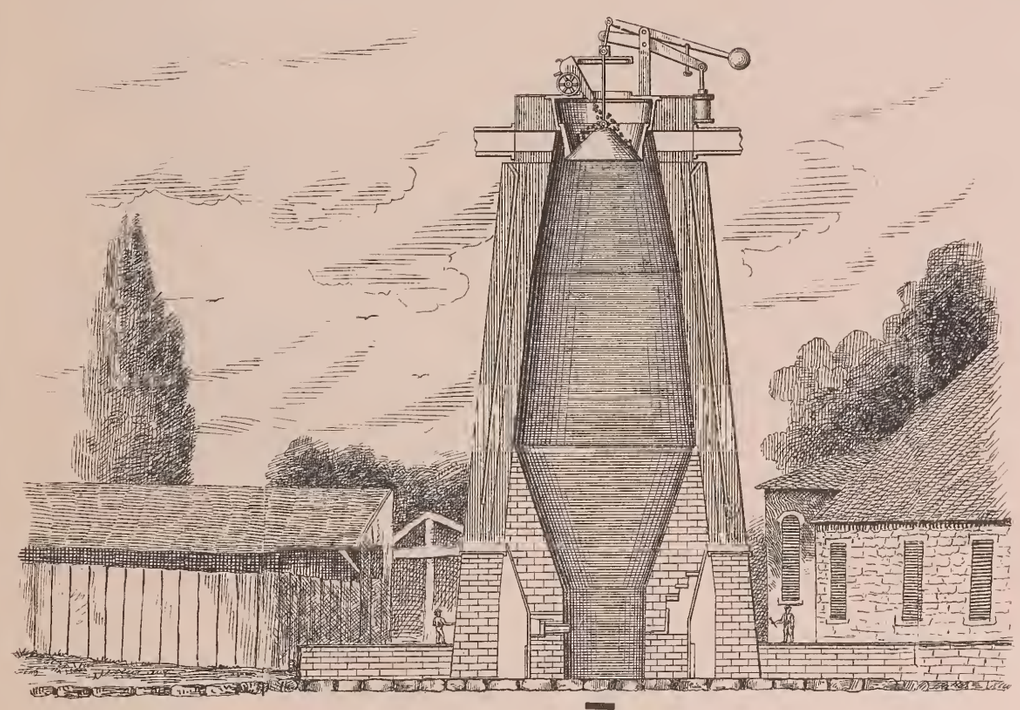
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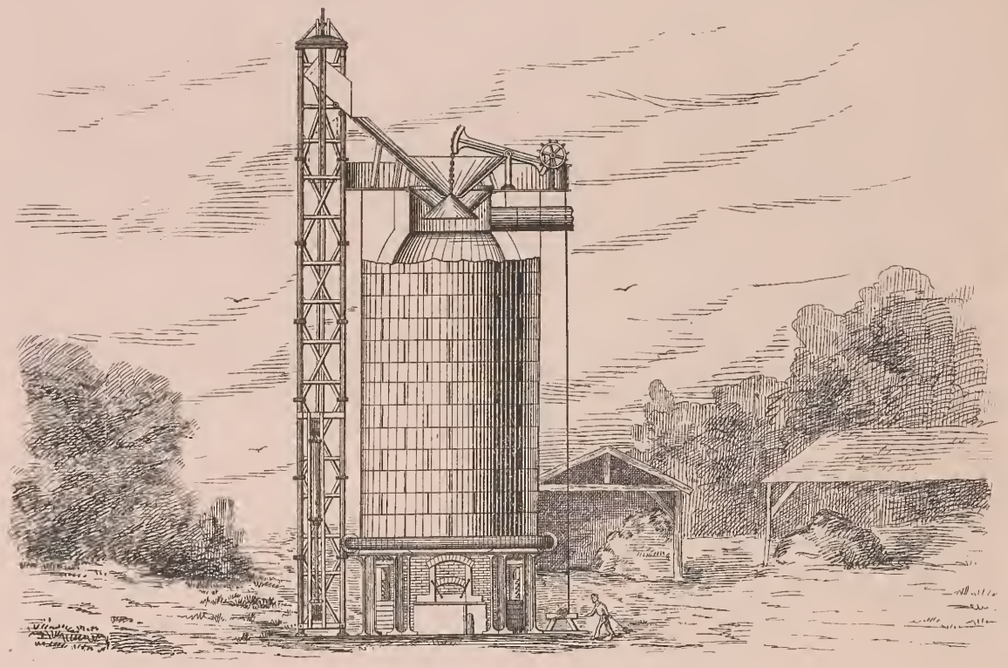
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8

BLAST FURNACES.

BLAST FURNACES.

No. 1. Primitive Roman.
2. " European—A. D. 1657.
3. " Northern Europe.
4. " Asiatic.
5. U. S. Patent, Smelting—A. D. 1828.
6. " " Calcining—A. D. 1864.
7. " " Iron Smelting—A. D. 1879.
8. " " Furnace Charging—A. D. 1882.

Seneca says that Democritus was the inventor of reverbrating furnaces.

In early times iron ores were reduced in a simple conical furnace called an air bloomery, which was erected on the top of a hill in order to obtain the greatest blast of wind.

The original of the Catalan furnace used in the Pyrenees Mountains since 1293 was a furnace two feet high, with a hearth or crucible eleven inches deep to receive the heated lump of metal. The blast was fed to the fire through two openings, called tuyeres, about eleven inches from the bottom. In five hours 140 pounds of iron could be made.

In the reign of Elizabeth, blast furnaces were constructed of sufficient size to produce from three to four tons of pig iron per day.

The first blast furnace in America is said to have been set up at Shrewsbury, N. J., in 1680.

Col. Spottswood opened some mines in Spottsylvania Co., Virginia, in 1715, and erected a blast furnace which was said to be the first regular furnace in the colonies.

The high blast furnace is supposed to have been introduced by the Belgians.

Henry Cort, of England, who received letters patent in 1784, for shingling, welding and manufacturing iron and steel into bars, has been called the father of the iron trade of the British nation. His was the original invention of the art of puddling iron.

The use of anthracite coal, as fuel for smelting furnaces, was tried as early as 1820, at Mauch Chunk, Pennsylvania.

The discovery of the superior power of hot over a cold blast in fusing refractory lumps of cast-iron was accidentaly observed by Mr. Jas. Neilson, of Glasgow, Scotland, about 1827, at a smith's forge in that city.

Since 1829 the air in the most improved blast furnaces is heated to 300° or more Fahrenheit.

The first iron produced by the use of the hot blast with anthracite was in the year 1835.

The modern blast furnace is built of masonry, and lined with fire brick. Iron ore, coal and limestone are put into the furnace, and a powerful current or blast of air is introduced, keeping the mass of ore, fuel and flux at a white heat until it is melted.

Charcoal 138 bushels, limestone 432 pounds, and ore 2,612 pounds, will produce one ton of pig iron.

In England temperature of hot blasts is 600°; density of blast and of refining furnace two and one-half to three pounds per square inch. Revolutions of puddling rolls, 60 per minute; rail rolls, 100; rail saw, 800; Horse power (indicated) required for different processes: blast furnace, 60; refining furnace, 26; puddling rölls with squeezers and shears, 80; railway rolling train, 250; small bar train, 60; double rail saw, 12; straightening, 7.

One pound of anthracite coal in a cupola furnace will melt from five to ten pounds of cast-iron; 8 bushels of bituminous coal will melt one ton of cast-iron. Small coal produces about three-fourths of the effect of large coal of the same kind.

The number of blast furnaces in the United States in 1878 was 700.

The product of blast furnaces of the United States in 1880: total pig iron, 3,781,021 tons.

985,208 tons of Bessemer steel were also produced in that year.

BLAST FURNACES.

490 Blast Furnaces in the United States.

	1880
Capital Invested,	$105,151,176.00
Value of Productions,	89,315,569.00
Wages Paid,	12,680,703.00
Hands Employed,	41,875

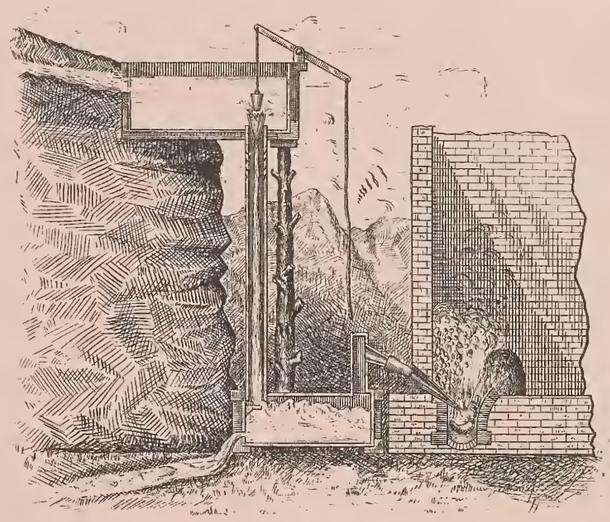
Capacity—	Primitive Mode.	Present Mode.
Tons Pig Iron per day.	4½	224

211 Patents Granted by the United States.

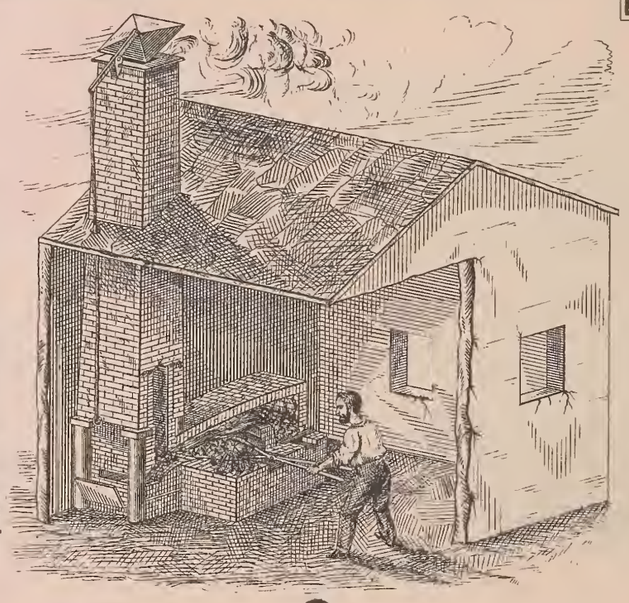
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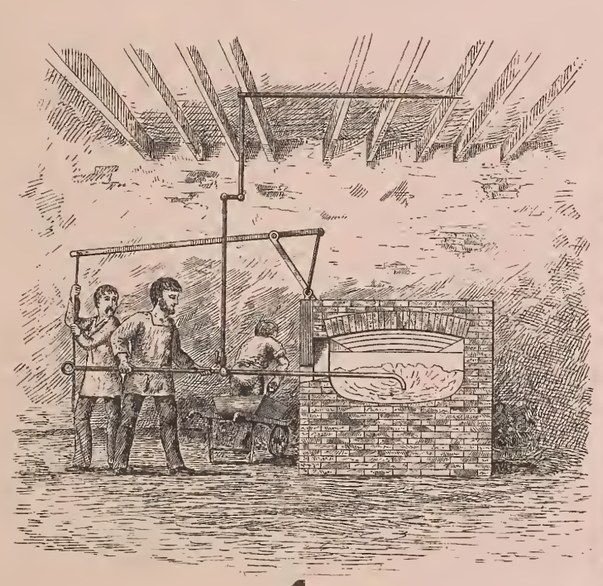
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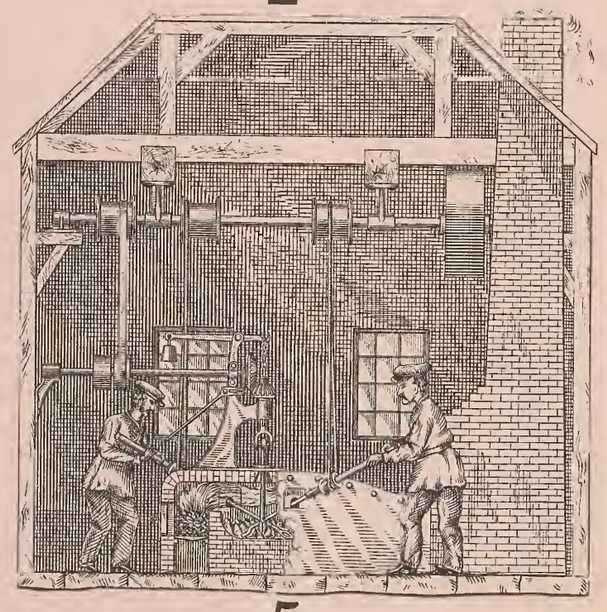
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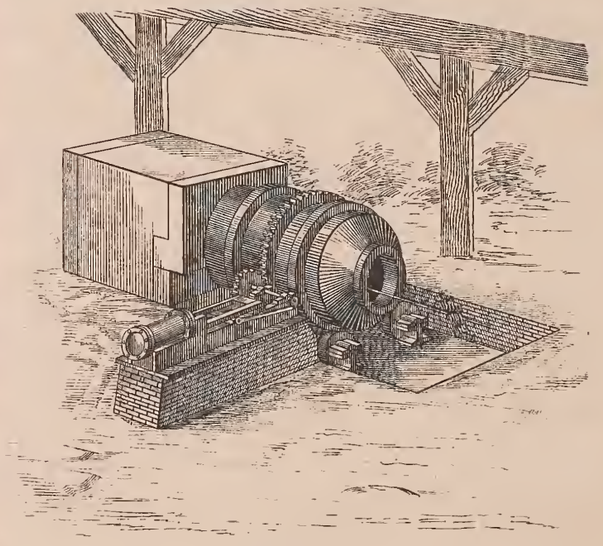
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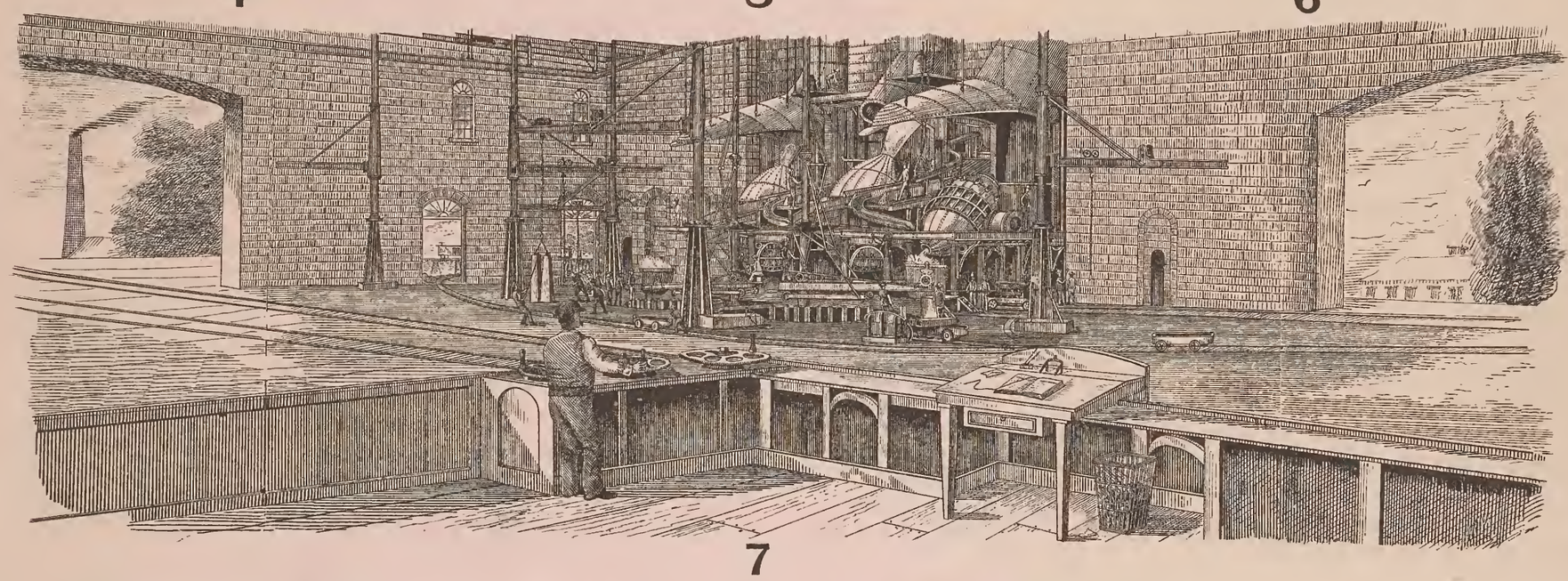
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IRON AND STEEL FURNACES.

IRON AND STEEL FURNACES.

No. 1. Primitive Persian Iron.
2. Catalan Forge, 18th Century.
3. Raising the Lump—A. D. 1854.
4. U. S. Patent, Steam Puddler—A. D. 1854.
5. " " Puddler—A. D. 1867.
6. " " Rotary Puddler—A. D. 1883.
7. " " Bessemer Plant—A. D. 1884.

The art of working metals is alluded to by Mnses, Gen. iv, 22, as existing before the deluge.

Iron was found, so says the Chronicle, on Mount Ida after the burning of the forests from lightning, at a period answering to our 1432 B. C.

Moses refers to an iron furnace 1490 B. C., and Job speaks of iron as "taken out of the earth."

Previous to 1100 B. C, the Israelites worked in the iron furnaces of Egypt during their captivity.

Jeremiah and Ezekiel speak of iron, and mention two qualities, one of which the latter calls bright iron (probably steel).

The same distinction is made by Hesiod, 850 B. C.

Steel was imported into Greece 500 B. C. from the Chalybes.

The ancient mines of Egypt have been explored by Europeans, and the processes used must have been wasteful, as the slag contains 53 per cent. of iron.

The early process for making steel is about identical with that still in use in India.

It is supposed that steel was known to the Egyptians. In the pictures decorating the tomb of Rameses III, bucklers are represented sharpening their knives upon what are supposed to be steel sharpeners.

In Jeremiah xv, 12, occurs the sentence, "Shall iron break the northern iron and the steel?"

The Hindoos still prepare steel in their primitive way; their name for it is "wootz." Their furnaces are small and built of clay, being four or five feet high, pear-shaped, measuring about two feet at the bottom and one at the top. The opening at the front is built up with clay for the smelting operation. The bellows used are made of goatskin, stripped off whole. The holes on the legs are tied up and a nozzle placed in the hole for the neck, while the air is supplied through the hole for the tail, which is closed when the air is blown out. With two such bellows worked alternately, one by each hand, a continuous blast is kept up of sufficient force to smelt the ore.

The celebrated Damascus blades, so highly valued for their temper and edge, were made from steel manufactured in India.

The Ancient Hindoos made steel in small quantities by taking their charcoal-made wrought iron, cut into small pieces, and putting about a pound of it at a time into a crucible with ten times the quantity of wood chopped fine; they put the crucible, tightly plugged, into a furnace and heated it intensely for two or three hours. At the end of the operation the steel was found fused into a cake in the bottom of the crucible.

From this steel was fashioned the famous cimeters and blades of the East, of such exquisite edge and temper as to cut a gauze veil floating in the air without disturbing its movement.

Accident first, and then experiment, led to the putting of other articles with the ore in the furnace, which caused it to melt more readily; as, for instance, limestone for iron ore.

The first process for obtaining the metal from the ore was simply to apply the greatest heat attainable. In time, crude furnaces were erected in which the heat could be made greater and the metal more readily and speedily extracted.

The Romans, during their occupation of Britain, manufactured iron to a considerable extent.

Dr. Livingston refers to the iron smelting furnaces of the tribes encountered in his explorations to the Gambezi river in Africa.

Iron ore was sent to England in 1610 by the Jamestown Colony.

Iron was manufactured from the ore in Virginia as early as 1620.

Charcoal was the only fuel used until 1618, when coal was introduced for this purpose.

In 1621 the works erected by Lord Dudley for smelting iron ore by the use of coal were destroyed by a mob. This employment of violence is said to have put off the general introduction of the process for nearly one hundred years.

In Western Europe, during the middle ages, the manufacture of steel was almost unknown.

In England the first patent for making steel was given in 1626 to Richard Lord Dacre, T. Letsome and N. Page.

Early in the 17th century a smelting furnace was erected near Yorktown, Va., by Gov. Spottswood. In 1622 the works were destroyed by the Indians, and their families, it is said, were massacred. These were the first iron works ever erected in America.

In 1645 John Winthrop, Jr., with some associates, obtained from the town of Boston three thousand acres of the common lands at Braintree for an encouragement and bounty for setting up iron works, and a monopoly of that business for twenty-one years.

The first blomary in America was established by James and Henry Leonard in 1652 at Taunton, Mass.

In 1670 mention is made of the process of making steel by boiling the material in "sow metal." This is supposed to be the method spoken of by various authors as in early use on the continent.

Captain John Smith first discovered the ore banks of Maryland, near Baltimore.

The first furnace for making pig iron in Maryland was established in 1715.

The manufacture of pig and bar iron was commenced in Virginia in 1715.

The first exportation of pig iron from America to England was three tons, shipped in 1718.

Cast steel was invented by Benjamin Huntsman, a German, in 1740.

The business of steel making was established in America as early as the Revolution, but it did not thrive until within the last forty years.

The first experiment of manufacturing iron by the use of anthracite coal was made in 1820 by some of the members of the Lehigh Coal Company.

The first manufacture in this country of wrought iron tubing and fittings for gas, water and steam pipes was commenced at Philadelphia in 1836.

In 1839 Heath, of Sheffield, England, devised and patented a mode of combining carboh with manganese to produce a carburet, which converted English iron into steel.

Henry Bessemer obtained his first English patent in 1855.

The process as employed in the United States is carried on under a combination of the Bessemer and Kelly patents. Wm. Kelly, of Eddyville, Ky., obtained a U. S. patent in 1851 for the process of manufacturing steel. Bessemer's process was introduced in 1856.

Steel has been defined as any kind of iron which, when heated to redness and suddenly cooled by being plunged into cold water, becomes harder.

There were eleven establishments in the United States for the manufacture of Bessemer steel in 1878, each having two converters.

No other material is so enhanced in price by the valuable qualities imparted to it by labor as iron.

It is stated that a bar worth $5 is worth $10 when made into horseshoes, $55 in the form of needles, $3,285 in penknife blades, and $25,000 in balance springs of watches.

IRON AND STEEL FURNACES.

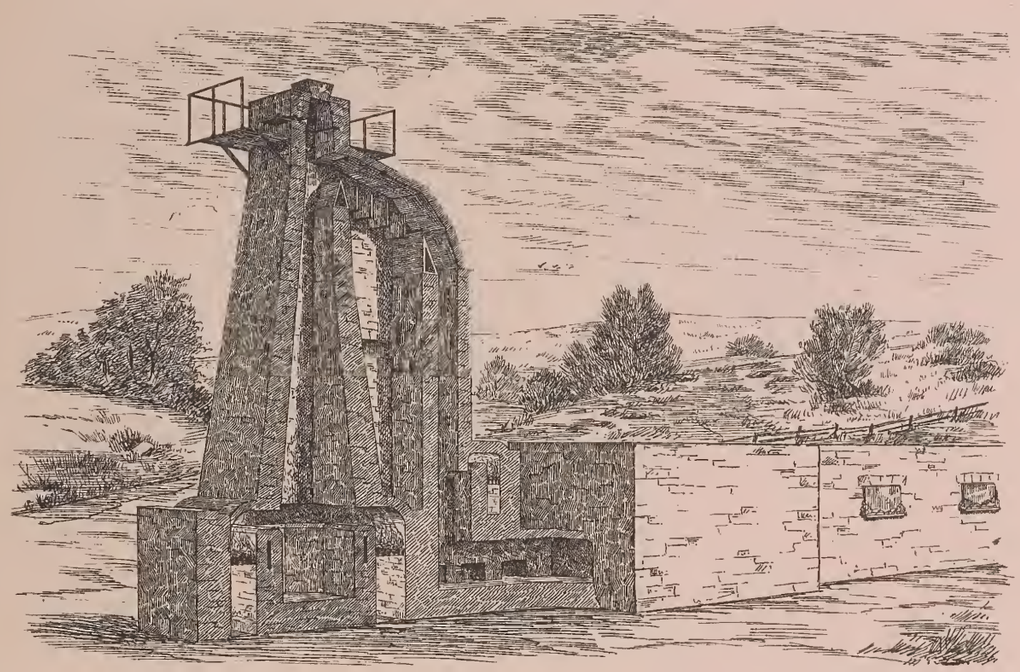
1,005 Manufactories of Iron and Steel in the United States.

	1870	1880
Capital Invested, -	$121,772,074.00	$230,971,884.00
Value of Productions,	207,208,696.00	296,557,685.00
Wages Paid, - -	40,514,981.00	55,476,785.00
Hands Employed, - - -	77,555	140,978

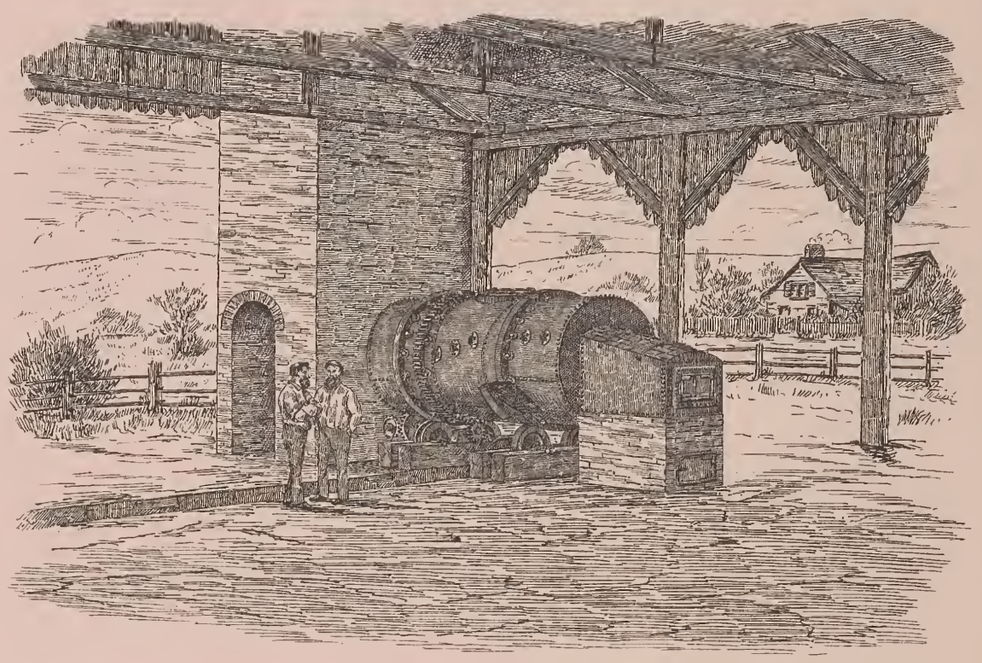
2,572 Patents Granted by the United States.

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Sims Litho Co New York

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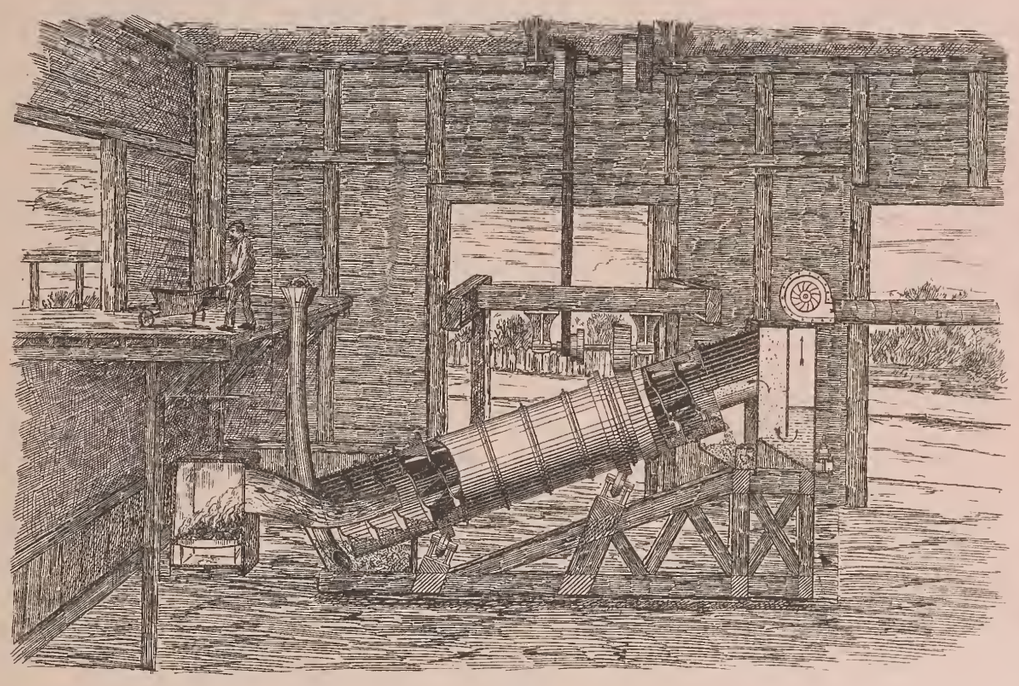


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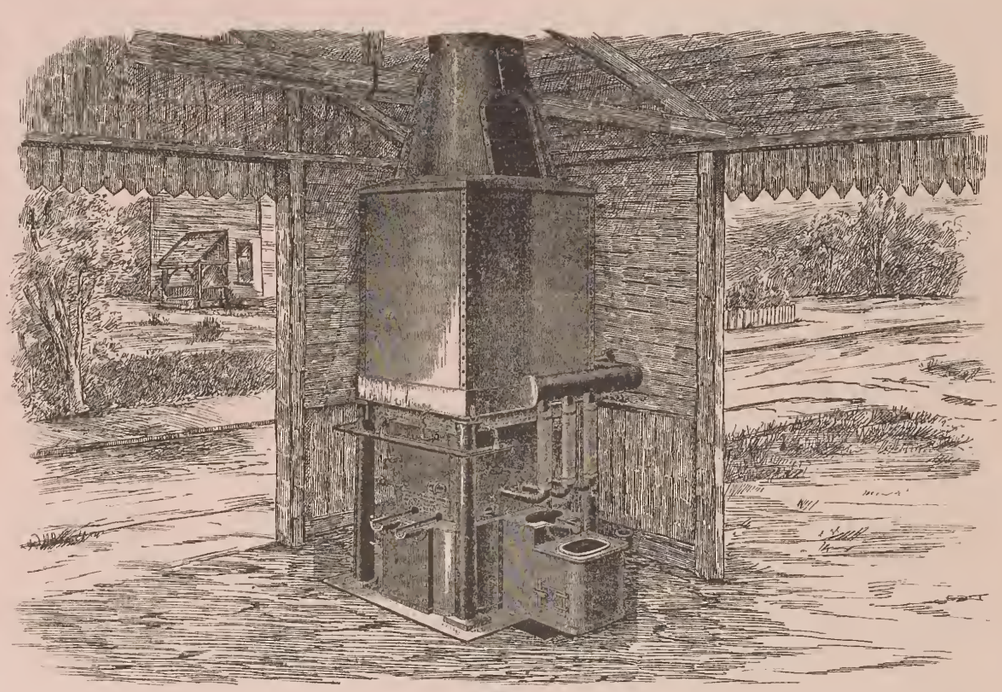


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METALLURGY--GOLD AND SILVER.

METALLURGY---GOLD AND SILVER.

1. U. S. Patent, Shaft Roasting Furnace—A. D. 1867.
2. " " Revolving Roaster—A. D. 1870.
3. " " Feeding and Discharging Roaster— A. D. 1876.
4. " " Water Jacket Smelter—A. D. 1880.

Silver and gold are first mentioned in the Bible about 1920 B. C.

Abraham, on his return from Egypt, is represented as being rich in cattle, silver and gold.

Diodorus, 10 B. C., states that "after the separation of the heavier particles of the ore, workmen take it away by weight and measure and put it with a fixed proportion of lead, salt, a little tin and barley, into earthern crucibles closed with clay; leave it in a furnace for five successive days and nights; when cooled the crucibles are opened and nothing is found but the pure gold."

Gold was undoubtedly the first metal used by man. It is found in a natural state, but slightly mixed with other metals.

In the early history of gold it was used for ornaments, in the arts and manufactures, and not as money. There is no well authenticated account of its use as money prior to the days of Julius Cæsar, 46 B. C.

Greece, for centuries, coined nothing but silver, because of the abundance of gold.

The surface finds of gold in India, China and Japan, were so great up to a thousand years ago that whole pillars of gold upheld the ornaments of the temples in those countries. India and China knew that if these pillars were melted down, and coined into money, the money would depreciate, and hence refused to recognize it as money.

The conquest of Mexico by Cortez, in 1519, was soon followed by the development of the rich silver mines of that country.

The metal was known to the Aztecs, and was worked by them in numerous ornamental and useful articles.

Pliny speaks of a mine opened by Hannibal, which supplied 300 pounds of silver daily.

The alchemists called silver "Linia," or "Diania."

The total production from the first working of the Mexican silver mines by the Spanish, to the time of their expulsion in 1821, was $2,368,952,000.

Since the opening of the Mexican mines in the 16th century their production has exceeded that of all other countries.

Gold was discovered in the Sacramento Valley, California, in 1848. This fact got noised abroad, and in three months upwards of four thousand persons were at work there digging for gold, and achieving remarkable success.

Alexander Parke, of England, patented in 1850 a process of extracting silver from lead by means of zinc.

Silver is separated from lead by repeated smelting and crystallization of the lead.

The gold furnace is built above the floor; the aperture for the fuel and crucible in each furnace is 9 to 16 inches square, and 12 to 20 inches deep.

Recovering silver by the Patio process is sometimes conducted on an immense scale.

In one instance, at the hacienda of Kegla, near Keal de Monte, there is an establishment the floor of which is one and one-half acres in extent, built in the most substantial manner, slightly sloping to facilitate the flow of water. The flooring consists of well-matched pine boards, and this vast receptacle sometimes contains as much as 1,000 tons of argentiferous slime, 30 tons of salt, 3 tons sulphate of copper, and 18,000 pounds of mercury in various stages of the amalgamating process.

The reason why this takes place in this well-known manner is because there is an affinity between the different ingredients employed in the operation.

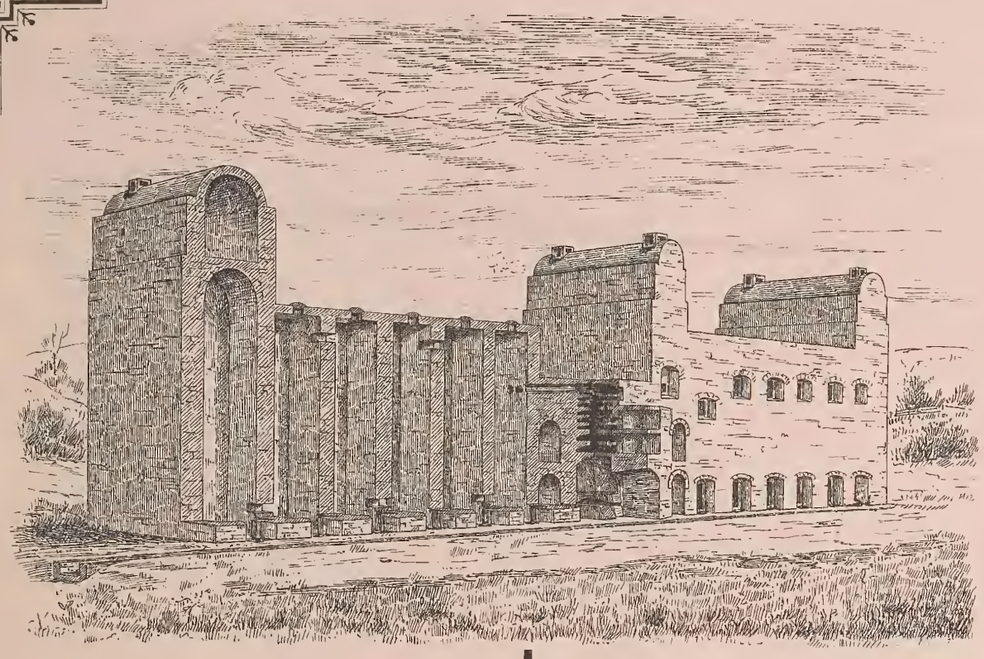
According to approximate estimates by the best American and German authorities, the total product of all the gold and silver mines in the world, from the year 1500 to 1874, is as follows: Pounds of gold, 17,000,000; valued at $6,450,000,000. Pounds of silver, 364,000,000; valued at $8,175,000,000. Total pounds of gold and silver, 381,000,000; valued at $14,625,000,000.

In 1810 the annual supply of bullion to Europe was estimated at $40,000,000, of which one-third was used for manufactures. At the present day the annual supply is much greater.

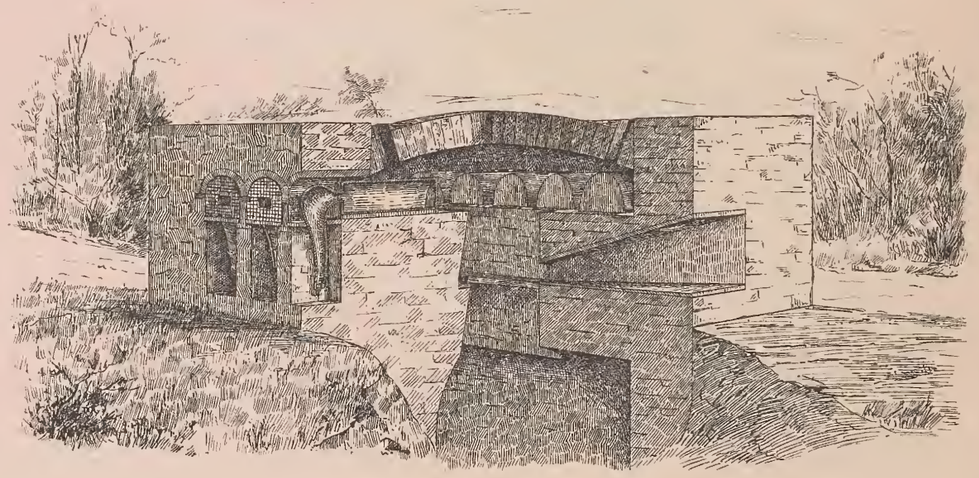
METALLURGY---GOLD AND SILVER.

791 Patents Granted by the United States.

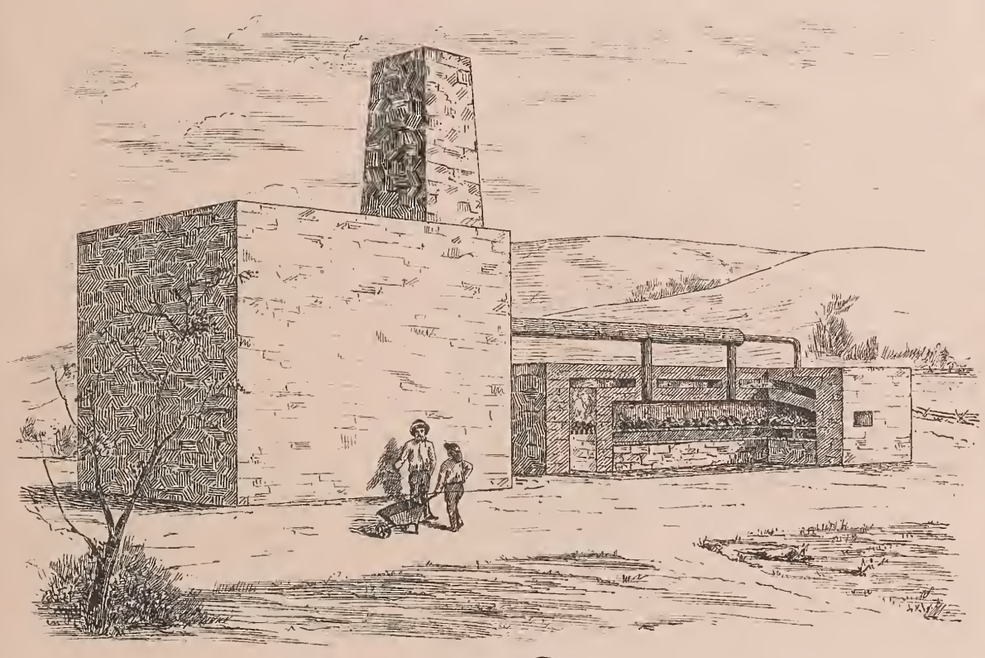
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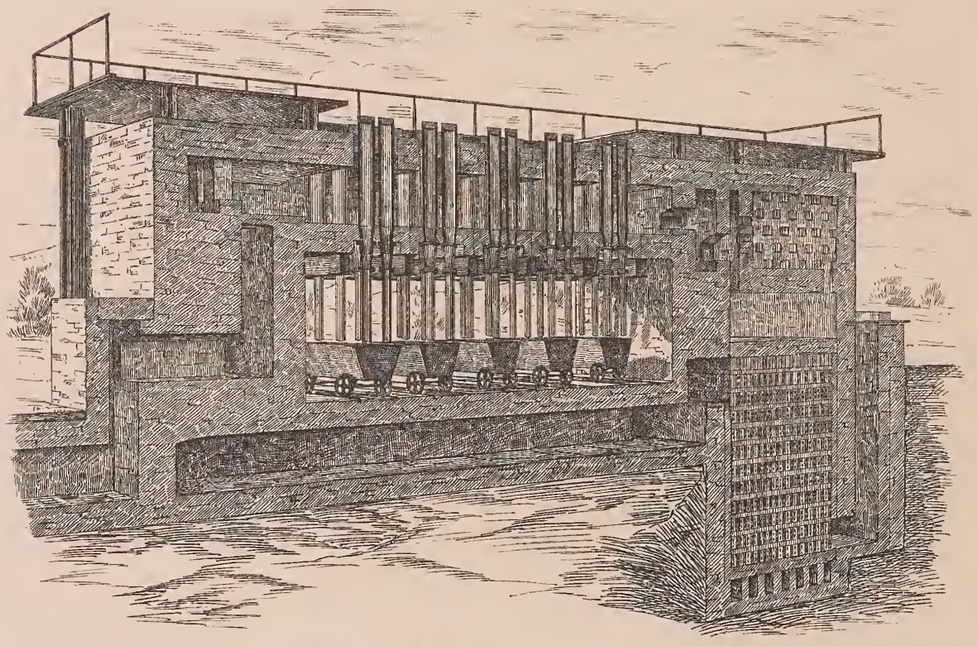
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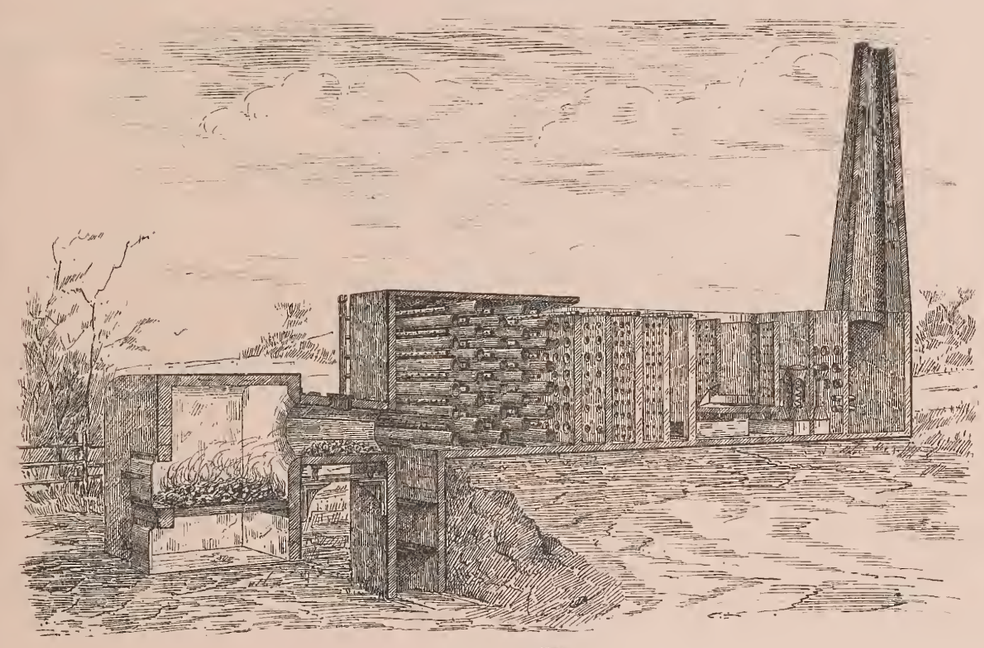
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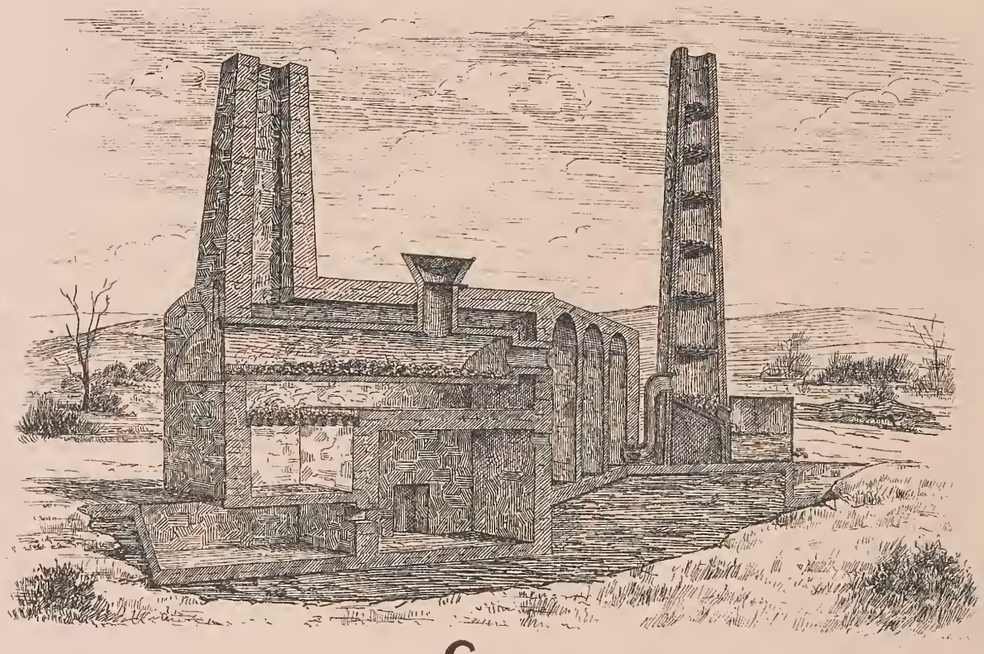
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METALLURGY--QUICKSILVER.

METALLURGY---QUICKSILVER.

No. 1. Spanish Quicksilver Furnace—A. D. 1700.
2. English Zinc Furnace—A. D. 1830.
3. Antimony Furnace—A. D. 1860.
4. Zinc Furnace—A. D. 1875.
5. U. S. Patent, Quicksilver Furnace—A. D. 1875.
6. " " Antimony Furnace—A. D. 1880.

Dioscoredes separated mercury from cinnabar.

Pliny states that 700,000 pounds of cinnabar were received yearly from Spain, and that the Greeks received it from there 800 years before he wrote. A. D. 70.

Cinnabar is of a bright vermillion color : its specific gravity is 13.6.

Quicksilver was well known in Peru among the Incas, but was only used to make the pigment vermillion.

It has been mined from time immemorial in Spain, at Almaden, where the old Aludel furnaces are still used.

Cinnabar is mined extensively in Idria, and is found in Hungary, many parts of Germany, China, Japan, Mexico, Honduras, Colombia, Peru and California.

The extensive mine at New Almada is 12 miles from San Jose, California.

The mode of mining and breaking the pieces suitable for the furnace has nothing peculiar to offer, but the condensing furnaces are worthy of notice.

They are sixteen in number, arranged side by side, and extend several hundred feet beneath a spacious roof; they stand 8 feet apart, are 40 feet in length, 10 in heighth and 8 in breadth. The ore is cleaned, broken and dumped into the receiving chamber, which is next to the furnace and holds seven tons of ore. The covers being luted on, the sublimated vapors pass by a circuitous route through twelve chambers successively, the connecting apertures being alternately at the tops and bottoms of the division walls. The mercury condensed in each chamber passes through small holes in the side to a curved trough on the outside, which conducts it to a reservoir, whence it is dipped into iron flasks, which receive a charge of 75 pounds and are then closed by a screw cap. While passing from the last of the twelve to the stack the vapor is brought into contact with a pan of water, which still further condenses escaping fumes.

The miners and those who merely handle the quicksilver are not injured thereby, but those who work about the furnaces and inhale the fumes of the metal are seriously affected. Salivation is common, and the attendants on the furnaces are compelled to desist from their labor every three or four weeks. The horses and mules are also salivated, and from 20 to 30 of them die every year from the effects of the mercury.

METALLURGY---QUICKSILVER.

35 Patents Granted by the United States.

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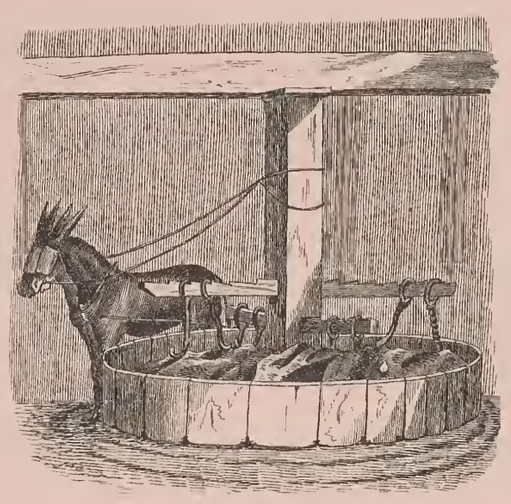
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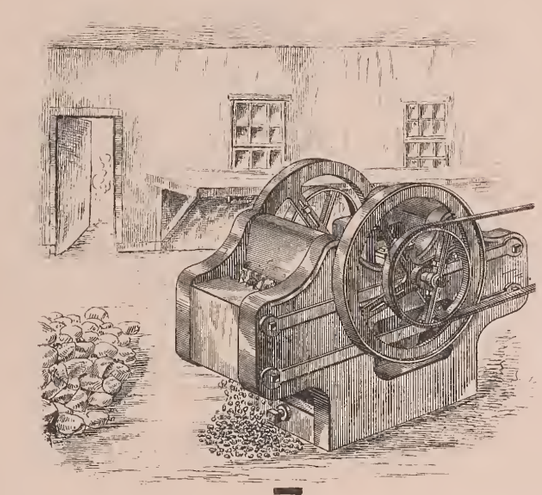
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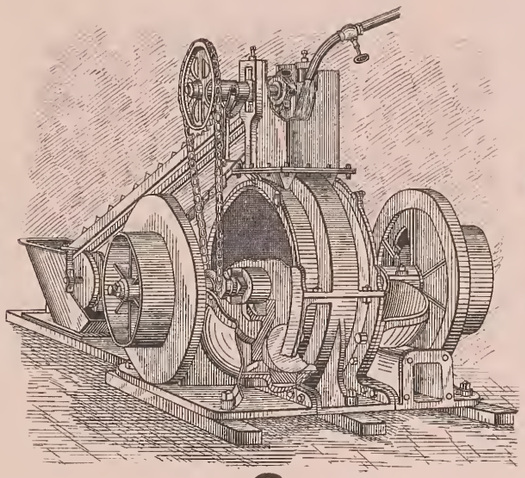
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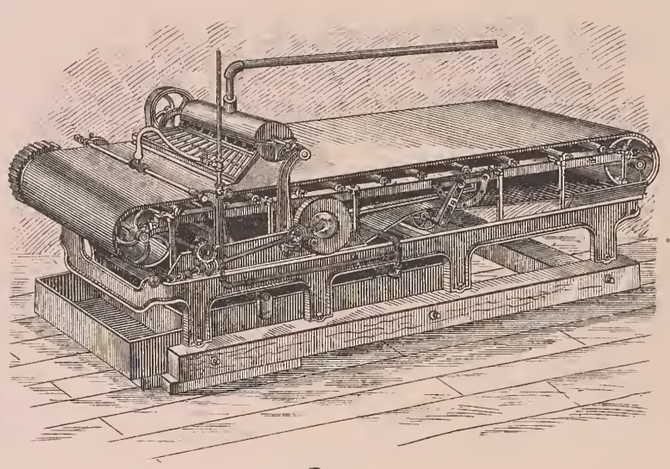
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9

REDUCING AND SEPARATING ORES.

REDUCING AND SEPARATING ORES.

No. 1. Primitive Stamp Mill—A. D. 1650.
2. Crushing Ores—A. D. 1690.
3. Primitive Ore Washer.
4. " Ore Collector
5. Mexican Arrastra.
6. Cradling
7. U. S. Patent, Ore Crusher—A. D. 1882.
8. " " Ore Pulverizer—A. D. 1883.
9. " " Ore Washing and Separating—A. D. 1884.

Diodorus, 10 B. C., states that the "marble shining quartz rock was excavated by iron picks and chisels, and carried from the bottom of the shafts to the open air by boys. It was then pounded by iron pestles in stone mortars till the pieces were reduced to the size of a lentel, and then ground in the ordinary hand mill to a fine powder; it was spread on a broad board, and water poured upon it and rubbed until the earthy matter was separated, which flowed away with the water, leaving the heavier particles on the board."

The principal supplies of gold in ancient Egypt were derived from the mines of the desert upper country; the gold was found in quartz rock. Agatharcides states that "the work of extracting the gold from these mines was immense. The rock was pounded fine by hand, and the gold separated by frequent washings."

This is confirmed by paintings on tombs.

The ancient Iberians, in the time of Strabo, washed gold-bearing earth in baskets.

In reducing silver ores the ancient Peruvians mixed them with galena, or lead, in portable ovens.

In 1519 sifting and wet stamping was introduced by Paul Grommesetter, a native of Schwarze, Germany.

Pliny speaks of collecting gold by means of an artificial river and sluices. He says: "The water is sometimes brought a distance of 100 miles."

The Mexican Arrastra will grind from six hundred to eight hundred pounds of ore in twenty-four hours.

The modern manner of reducing and separating ores is: The ores, having been raised to the surface, are first dressed, that is, prepared for smelting. This includes the various operations of sorting, stamping and roasting. Sorting consists merely in the separation of the different pieces of ore into lots, according to the products they are expected to afford and the treatment they are likely to require. After the ore is sorted it is carried to the stamper, or stamping mill, which consists either of hammers or iron cylinders, driven up and down, which serves to break up the ore, together with its gangue, into a coarse powder. To this succeeds the washing of the powdered ore in troughs or inclined planes, crossed by a current of water, the heavier ore remaining, while the lighter earthy and stony substances are carried away by the water. The ore is then ready for roasting.

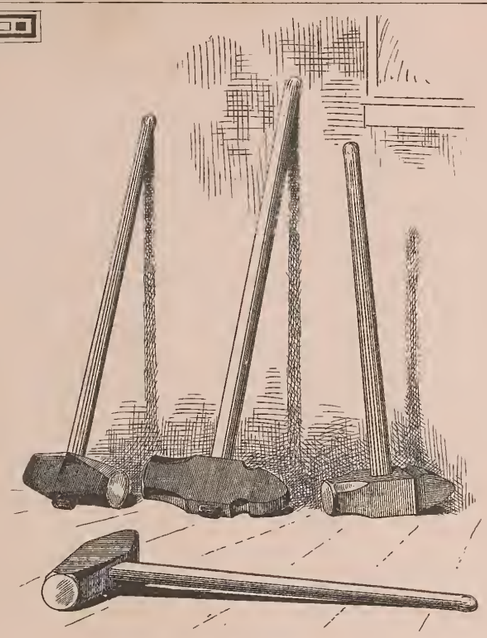
Some ores do not require all these operations. Copper ore, for example, is not stamped, but broken into small fragments by the hammer. In other cases roasting is unnecessary.

The different modes of collecting gold are known as panning, winnowing, cradle rocking, washing with Long Tom, jamming or turning the course of a river, burrowing, ground sluicing, and hydraulic processes.

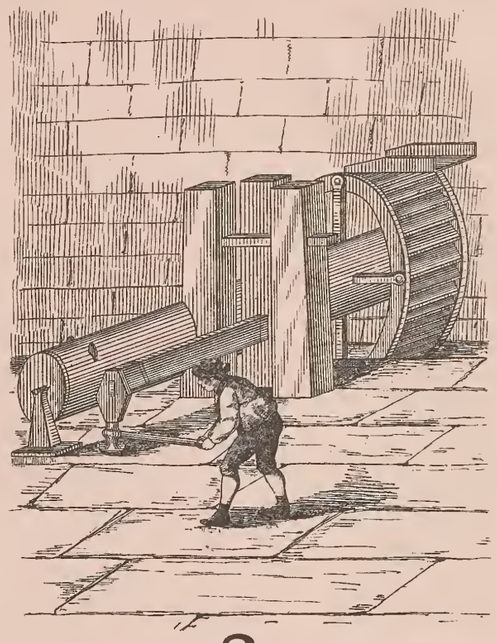
REDUCING AND SEPARATING ORES.

1,051 Patents Granted by the United States.

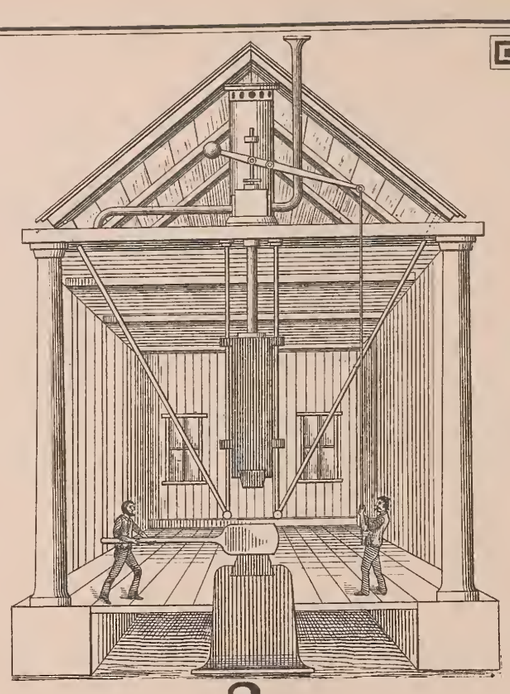
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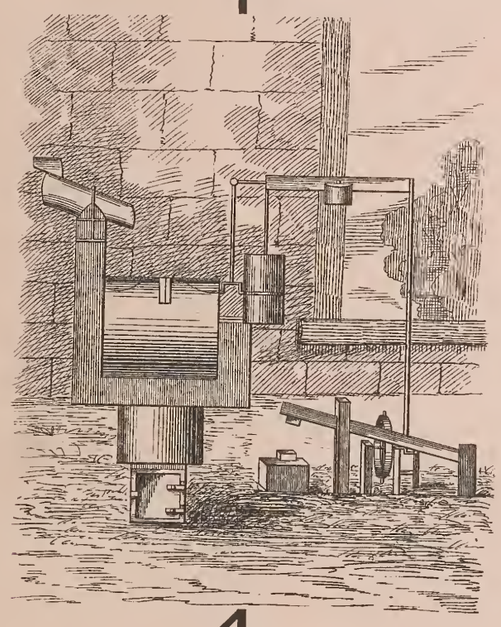
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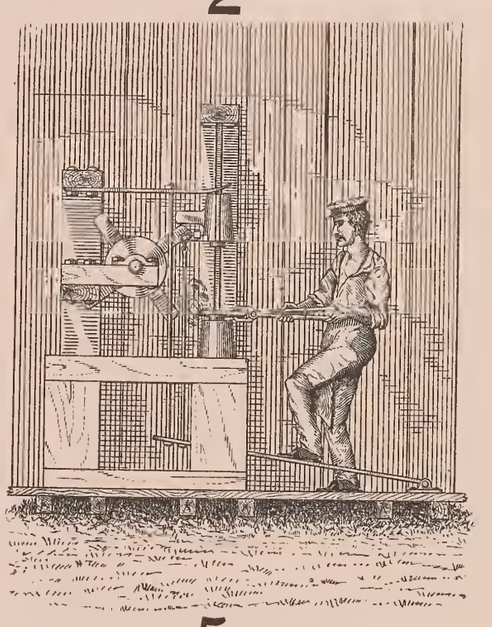
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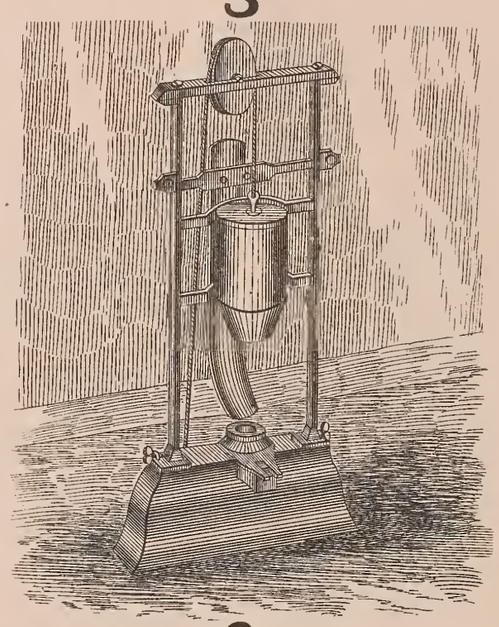
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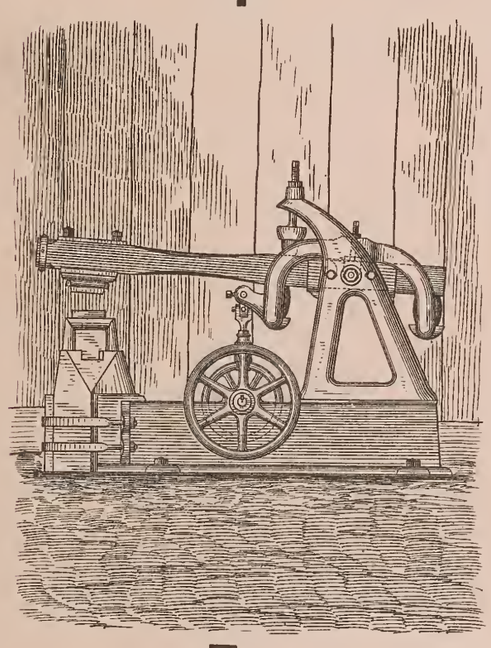
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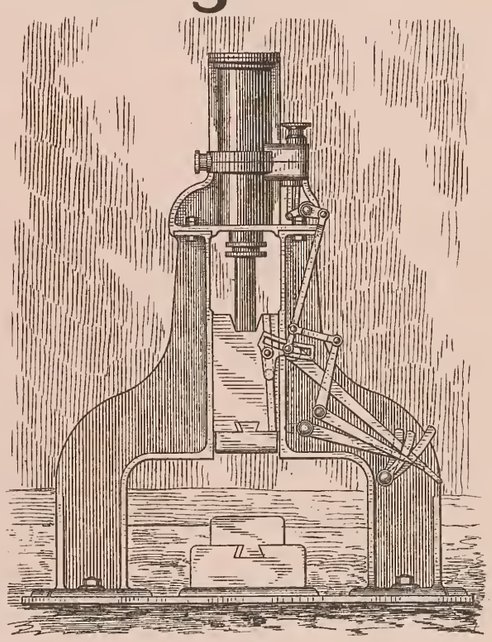
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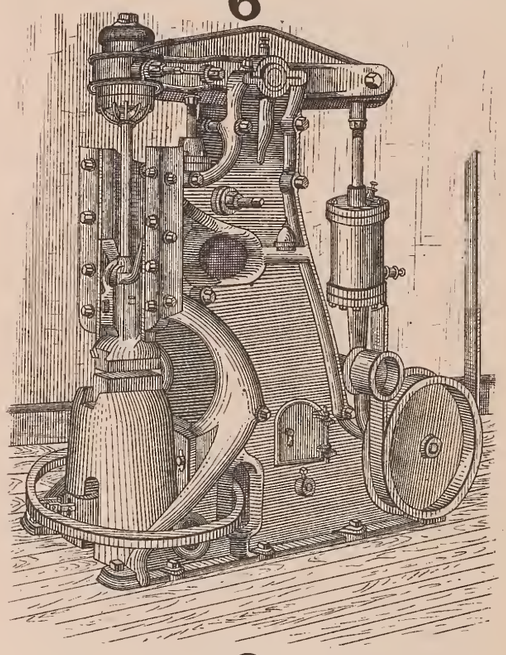
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9

FORGING AND WELDING.

FORGING AND WELDING.

1. Primitive Sledge Hammer.
2. French Water-Wheel Forging Machine.
3. English Steam Forging Machine—A. D. 1801.
4. U. S. Patent, Foot Power Forging Machine—A. D. 1833.
5. " and English Patents, Steam Forging—A. D. 1843.
6. " Patent, Drop Hammer—A. D. 1857.
7. " " Helve Hammer—A. D. 1873.
8. " " Steam Hammer—A. D. 1880.
9. " " Atmospheric Hammer—A. D. 1882.

The Romans discovered plenty of iron in Britain and established foundries for manufacturing spears and other military implements in the forests of Dean. Their forges and tools, together with great heaps of the iron, stone, cinders, &c., have been dug up.

The first iron forge in America was established in 1652 at Raynham, a town of the Plymouth Colony.

The manufacture of iron was commenced in Pennsylvania about 1720 by a settler named Nutt, who erected a forge in Coventry.

The English Parliament, to protect the iron industry in England, passed, in 1750, an act prohibiting the erection of any iron rolling or slitting mill, or any forge, in the American Colonies.

When illumination by gas was first introduced to any great extent in England, the old musket barrels, laid by in quiet retirement from the fatigues of the last war, were employed for the conveyance of gas. The breech ends of the musket barrels were broached and tapped, and the muzzles were screwed externally to connect the two without detached sockets. From the rapid increase of gas illumination the old gun barrels soon became scarce, and new tubes with detached sockets made by the old barrel forgers were first resorted to. This led to a series of valuable contrivances for the making of wrought-iron tubes, commencing with the Russel patent of 1824, under which the tubes were first bent up by hand, hammers and swages.

In 1828 Mr. Samuel Collins, of Connecticut, built a trip hammer shop in Collinsville, and commenced making broad axes with trip hammers, each man tempering his own. One person could forge and temper eight axes per day.

Before the invention of the steam hammer in 1839, large forge hammers actuated by steam had been in use, but in an indirect manner, the hammer having been lifted by cams and other expedients, which rendered the apparatus cumbersome, costly and very wasteful of power on account of the indirect way in which the original source of the force had to reach its point of application by giving the blow to the hammer.

The mode of joining steel to iron by welding, instead of riveting, is said to have been discovered by Sir Thomas Frankland.

The first application of steam to the hammer was to the tilt, which was worked by cams on a rotary shaft by the steam engine.

The steam hammer at the Bessemer Steel Works at Harrisburg, Pa., weighs 35,000 pounds, and is said to be the largest in the United States.

In his story, told in the *London Graphic*, of his journey to Kilmajaro, Africa, Mr. H. H. Johnston describes a native forge:

The Ma-Chaga, he says, are clever smiths, and forge all kinds of utensils, weapons and ornaments from the pig iron they receive from the country of Usanga, near Lake Jipe. The forge is but a pair of goat skin bellows, converging into a hollow cone of wood, to which are added two more segments of stone pierced through the nozzle, which is thrust into the furnace of charcoal. The bellows are kept steady by several pegs thrust into the ground, and a huge stone is often placed on the pipe to keep it firm. After the iron has been heated white hot in the charcoal, it is taken out by the iron pincers and beaten on a stor : anvil. The Chega smiths not only make spear blades and knives of apparently tempered steel, but can fabricate the finest and most delicate chains.

The best way of welding cast-iron is to take it at a very intense heat, closely approaching the melting point. In this state it will be found sufficiently malleable to stand welding by the hammer. There are other methods, but most of them are attended by almost insurmountable difficulties.

Iron while heating, if exposed to air, will oxydize; when at white heat, if in contact with coal, it will carbonize, or become steely. Iron should be heated as rapidly as possible.

The steam hammer recently completed at Creusot is the largest and most powerful instrument of the kind in the world. The hammer in the workshops of Herr Krupp, at Essen, weighs fifty tons, and descends through a maximum space of three meters; but the hammer of the Creusot engine, weighing between seventy-five and eighty tons, has a course of five meters—the energy of the blow struck by it being 412,500 kilogramme-meters, while the Krupp instrument can only develop 150,000 kilogramme-meters of work. The foundation on which the anvil rests consists of masonry five meters in depth, the space between the level of the ground and the cast-iron table being filled in with stout wooden beams, disposed alternately in horizontal and vertical layers, so as to give an elastic bed. Altogether, 100 cubic meters of cast-iron, 100 cubic meters of wood and 1,000 cubic meters of masonry have been employed to form this foundation.

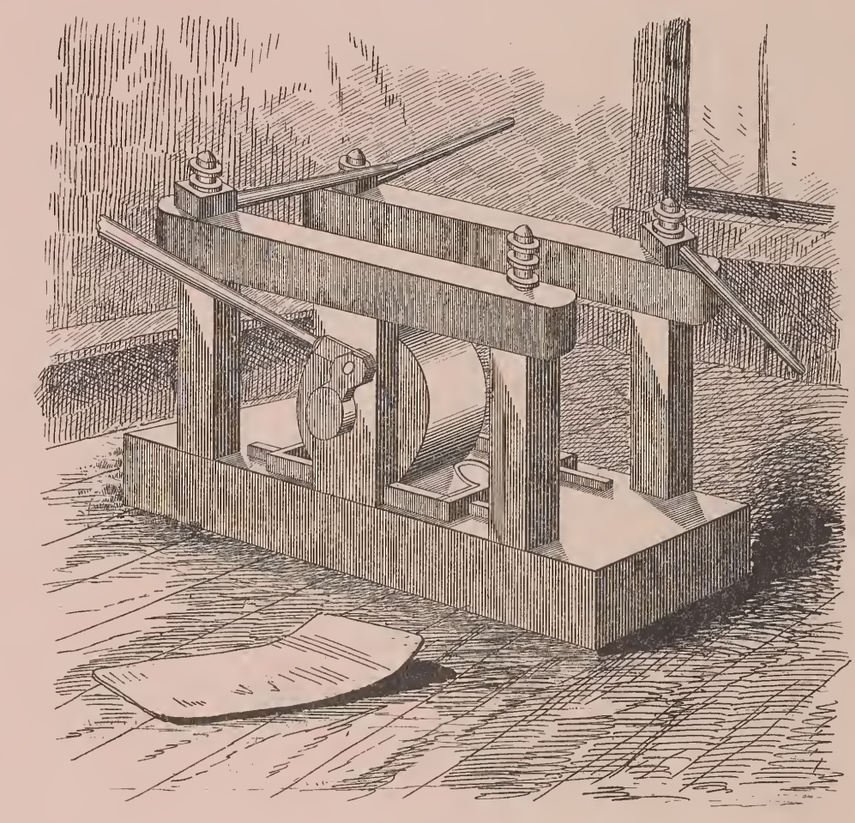
FORGING AND WELDING.

656 Patents Granted by the United States.

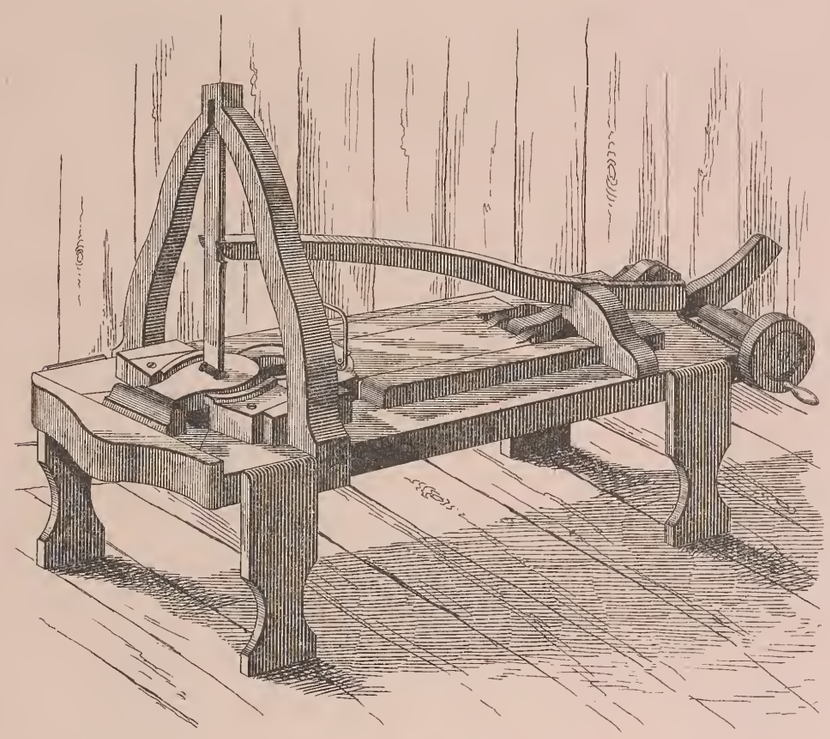
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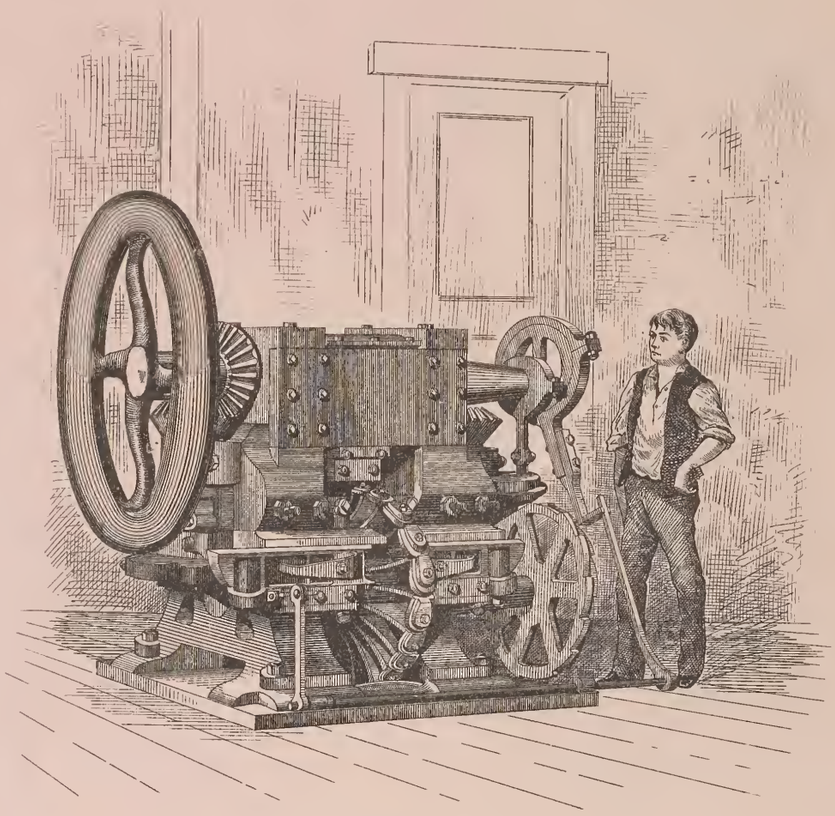
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HORSE-SHOE MAKING.

HORSE-SHOE MAKING.

No. 1. Primitive Hand Making.

2. U. S. Patent, Horse-shoe Machine—A. D. 1828.

3. " " " " —A. D. 1875.

4. " " " " —A. D. 1879.

Horses were not shod in Egypt.

Aristotle and Pliny mention the covering of horses' feet in stony places to protect the hoof from breaking.

In Japan the horses have clogs of twisted straw.

Camels in olden times were similarly provided.

The mules of Nero were shod with silver; those of his wife with gold.

The first mention made of shoes being nailed to the hoofs, is by Emperor Leo, in the ninth century.

Horse-shoeing was introduced into England by William I.

In 1810 Rotch obtained an English patent for an elastic horse-shoe, consisting of a sheet iron sole attached to an india rubber upper which was slipped upon the foot, clasping the crown and encircling the pastern. Dudley's cast iron horse-shoe, English patent of 1823, was cast in a mold modeled from the foot of the horse.

Burden, of Troy, N. Y., patented a machine for making horse shoes in 1835, which, with improvements, revolutionized this branch of business.

Horse-shoes made by machinery are now generally used; they are made of five sizes, numbered from 1 to 5. Besides these shoes proper, there are several attachments, such as snow pads, movable calks, &c., &c.

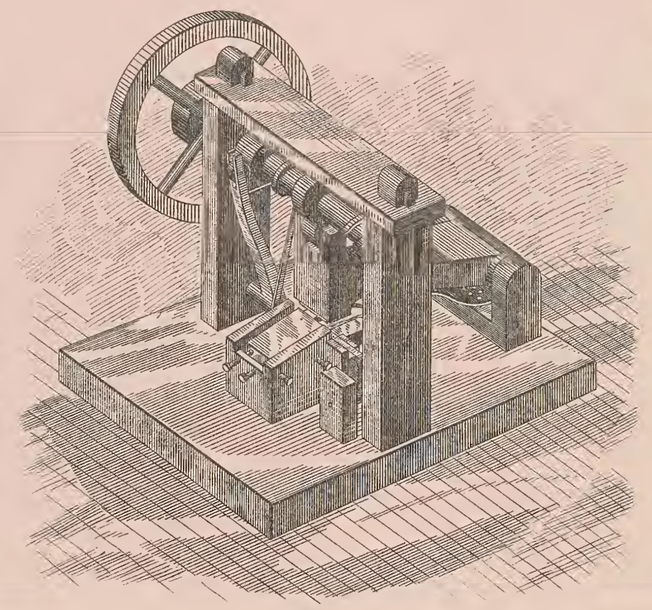
HORSE-SHOE MAKING.

326 Patents Granted by the United States.

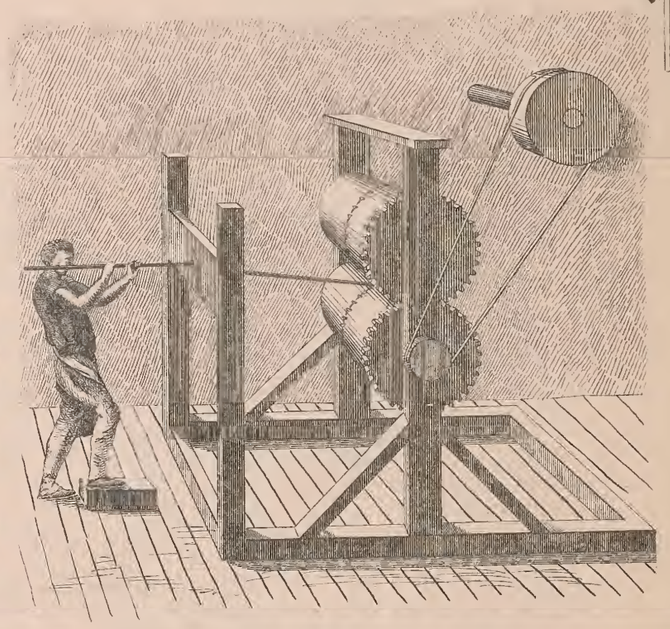
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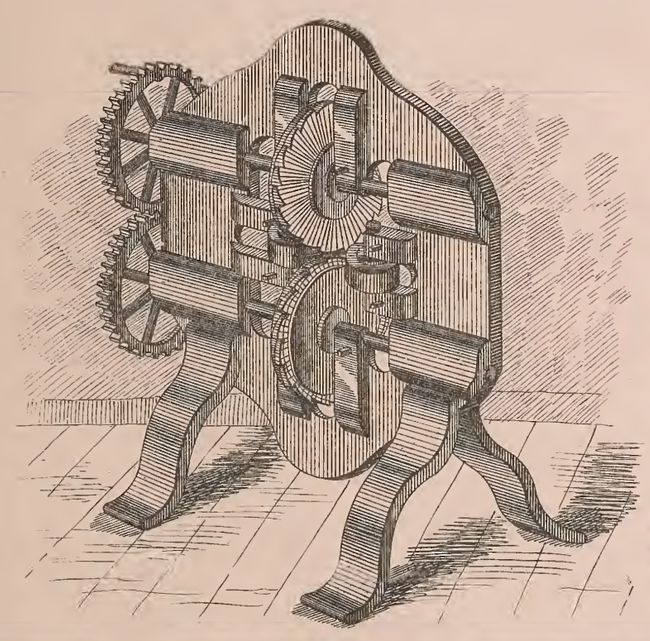
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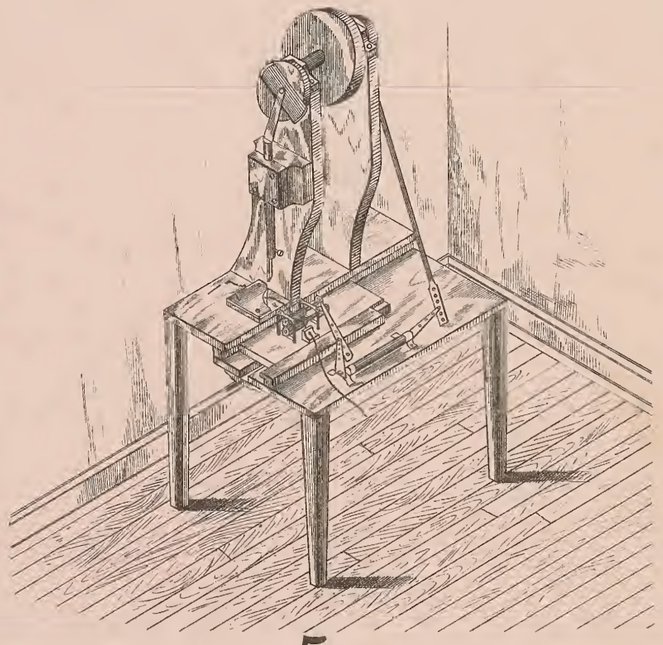
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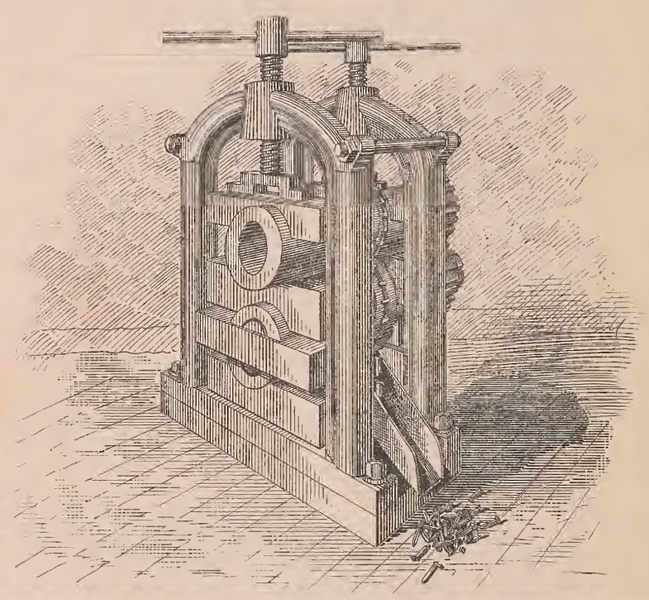
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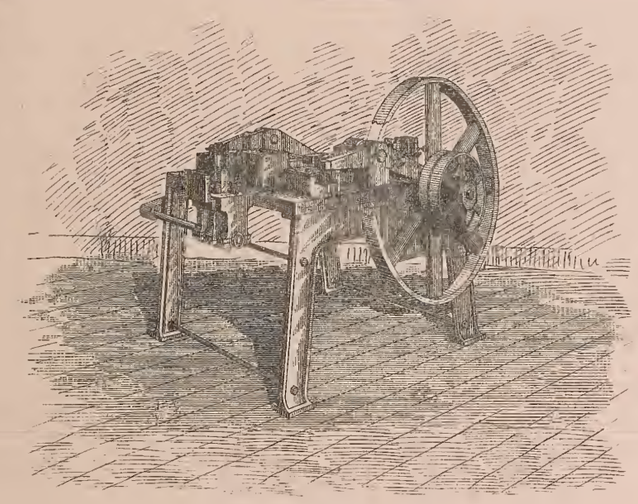
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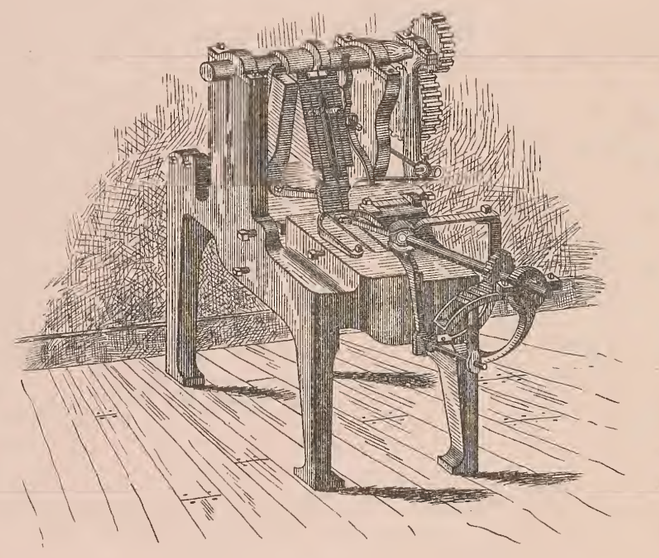
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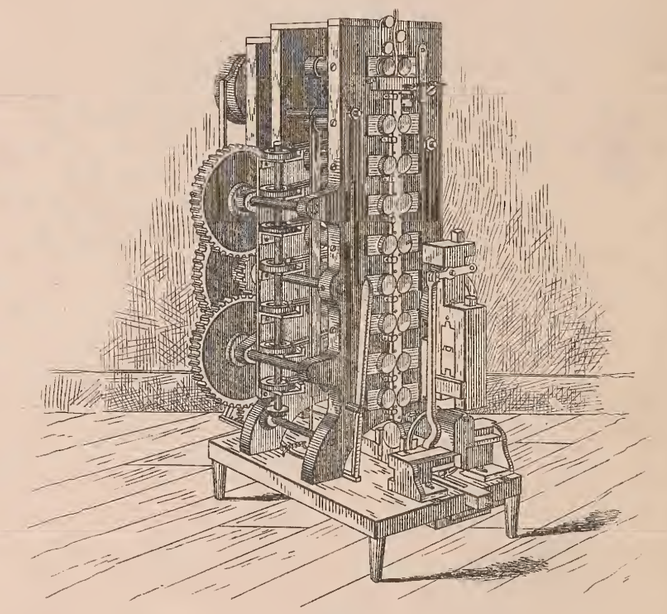
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9

NAIL MAKING.

NAIL MAKING.

No. 1. Primitive Hand.
2. U. S. Patent, Cut Nail Machine—A. D. 1810.
3. " " Wire Nail—A. D. 1834.
4. " " " " —A. D. 1848.
5. " " Corrugated Nail Machine—A. D. 1874.
6. " " Spike Machine—A. D. 1881.
7. " " Wrought Nail Machine—A. D. 1883.
8. " " Tack Machine, Automatic Feed—A. D. 1884.
9. " " Horse-shoe Nail Machine—A. D. 1884.

In 1506 letters patent were granted by King James, of England, to Sir Beres Bulmer for the cutting of iron into small bars or rods to serve for making nails.

Clement Dawbney obtained an English patent for cutting nail rods, in 1718, which was operated by water power.

Cut nails were first made in the United States in 1775.

In 1786, Reed, of Massachusetts, constructed a machine for cutting nails from the plate, and in 1798 obtained a patent for cutting and heading at the same operation.

Clifford, of England, was granted a patent in 1790 for making nails by swaging between rollers. The first United States patent for machine for cutting nails was granted J. G. Pearson, of New York, March 23, 1794.

Perkins patented, in 1795, a machine which it was stated could make 200,000 nails per day.

Machinery for splitting rods for nail making was first introduced in Sweden. Foley, an Englishman, traveled to Sweden, worked his way into their mills, took notes of their machinery, and brought them to England, where he established a factory.

In the year 1811 a Birmingham firm made the experiment of cutting nails out of sheets of iron by ingeniously contrived machinery, and by the year 1820 such improvements had been made as had placed the experiment beyond the bounds of hypothesis and within the circle of trade routine. About the same time American manufacturers adopted similar processes, so that the use of this kind of machinery would appear to have been contemporaneous in both countries.

The American nail cutter was the first to cut the nails and swage the heads at one operation.

Before the introduction of machinery it is estimated that 60,000 persons were employed at Birmingham, England, in making nails by hand.

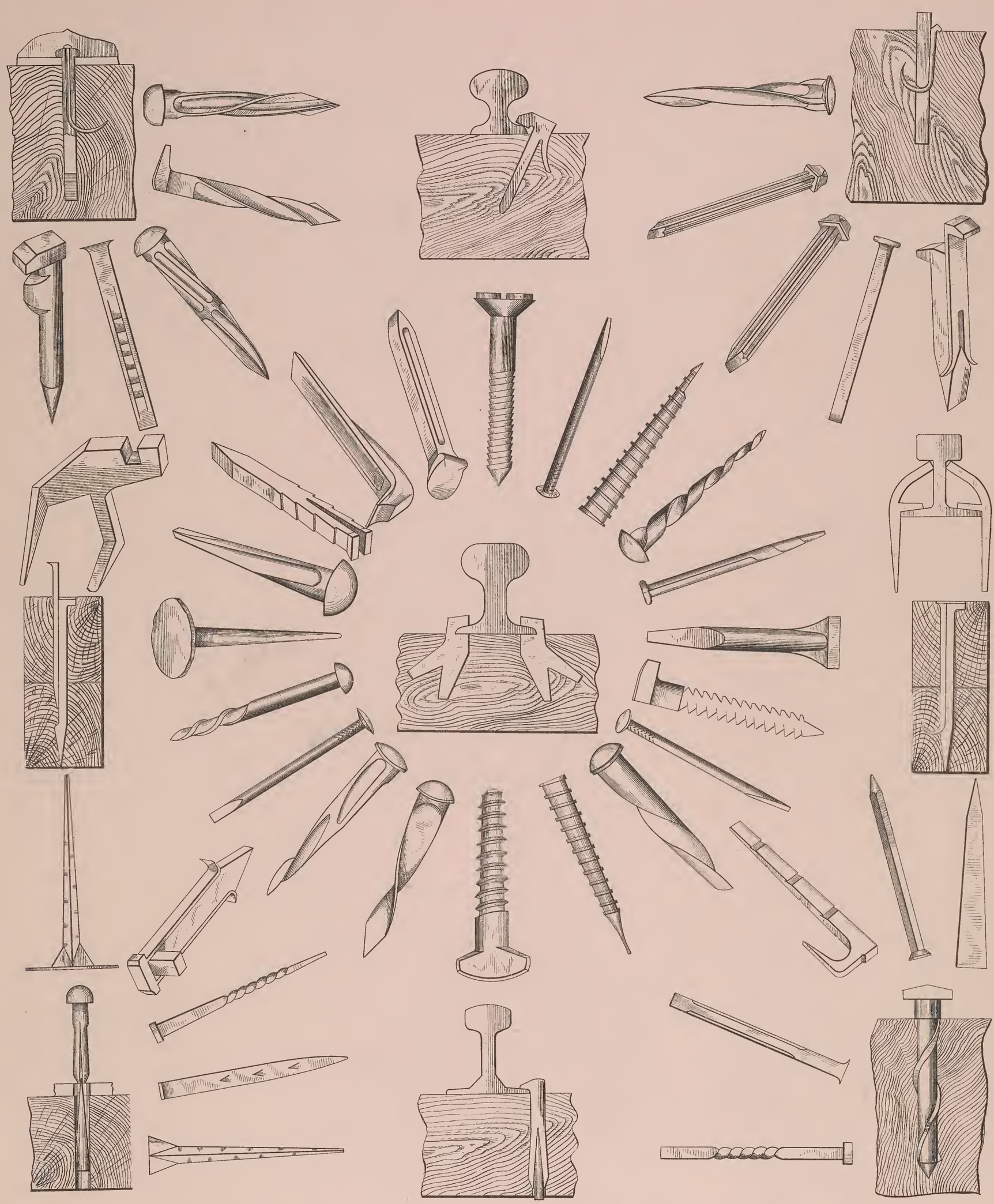
The latest perfected nail machines will turn out about 40,000,000 nails a week.

NAIL MAKING.

Capacity—per day of 10 hours:	Primitive Mode.	Present Machine.
By hand, Nails,	1,000	
Horse-shoe Nail Machine,		60,000
Tack Machine,		180,000
Spike Machine,		240,000
Corrugated Wire Nail Machine,		90,000

770 Patents Granted by the United States.

Sackett & Wilhelms Litho Co. New York



TYPES OF NAILS AND SPIKES.

NAILS AND SPIKES.

62 Manufactories in the United States.

	1860	1880
Capital Invested, -	$5,810,250.00	$9,877,805.00
Value of Productions, -	9,857,223.00	21,924,540.00
Wages Paid, - -	2,398,872.00	5,255,171.00
Hands Employed, - - -	6,878	8,910

117 Patents Granted by the United States.

Hardly any kind of hardware can boast of greater antiquity than nails, inasmuch as they are mentioned in the 4th chapter of the Book of Judges, and in other parts of the Bible.

The nails of ancient Egypt were of bronze.

There are about 300 varieties of nails in use, and ten sizes of each kind.

The term tenpenny, when applied to nails, is probably a corruption of pound, thus: a thousand fourpenny nails weigh four pounds, and one thousand tenpenny nails weigh ten pounds.

Nails are assorted: 1st, as to purpose used, as hurdle, pail, deck scupper, sheathing, fencing and slating; 2d, form of the head, as rose, clasp, diamond, billed, clout and counter sink; 3d, form of points, as flat, sharp, spear and clinch; 4th, thickness, as fine, bastard, strong; 5th, sizes, as one-half to forty lbs.; 6th, material, as copper for sheathing ships, metal for roof coverings; 7th, mode of manufacture, as wrought, cut and cast.

Some nails are so small that 1,000 weigh only one and one-half ounces.

It is said that there are about 2,000 kinds of nails and rivets made and used for an almost infinite variety of purposes.

It is predicted that in the course of the next five years steel nails will have as completely supplanted iron nails as the steel rail has its iron predecessor. It is said that steel nails can be made cheaper than those made of iron.

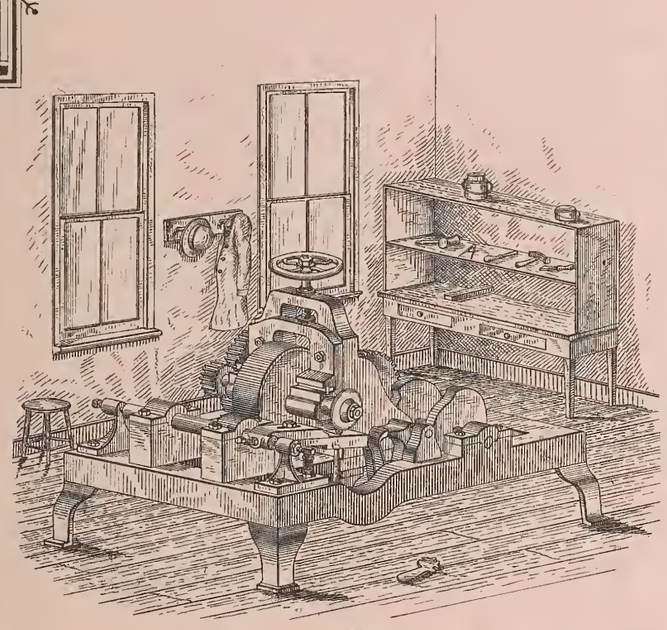
Spikes are nails larger than tenpenny, viz: 12-d are 3¼ inches long, 45 to pound; 16-d are 3½ inches long, 28 to pound; 20-d are 4 inches long, 20 to pound; 30-d are 4½ inches long, 16 to pound. Railway spikes are larger.

Spikes are known by shape, character, purpose, quality or size, as flat, narrow flat, wide flat, grooved, swelled, notched, barbed, forked, cylindrical, square, &c.

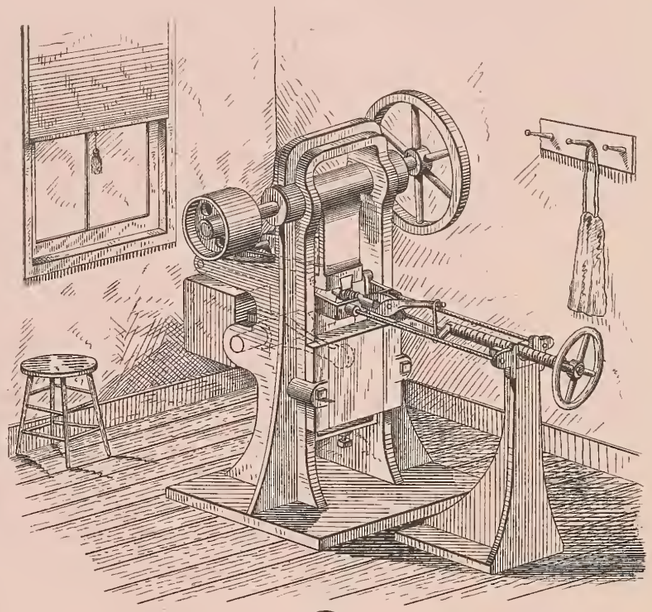
NAILS AND SPIKES.

U. S. PATENTS
FROM
A. D. 1805
TO
A. D. 1884.

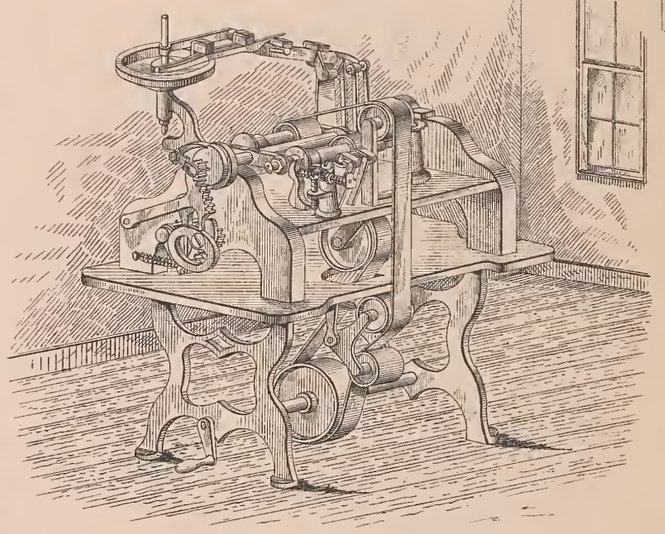
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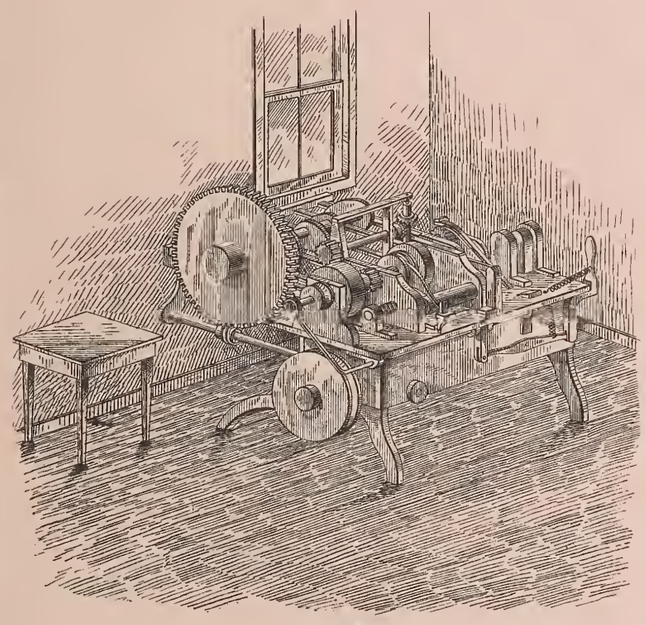
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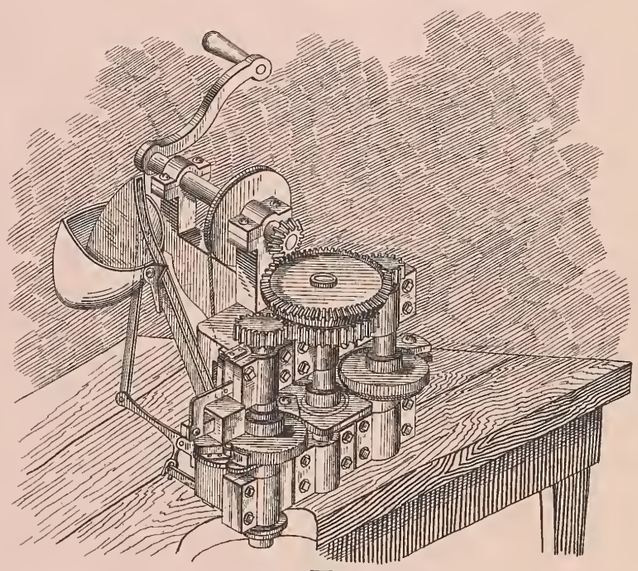
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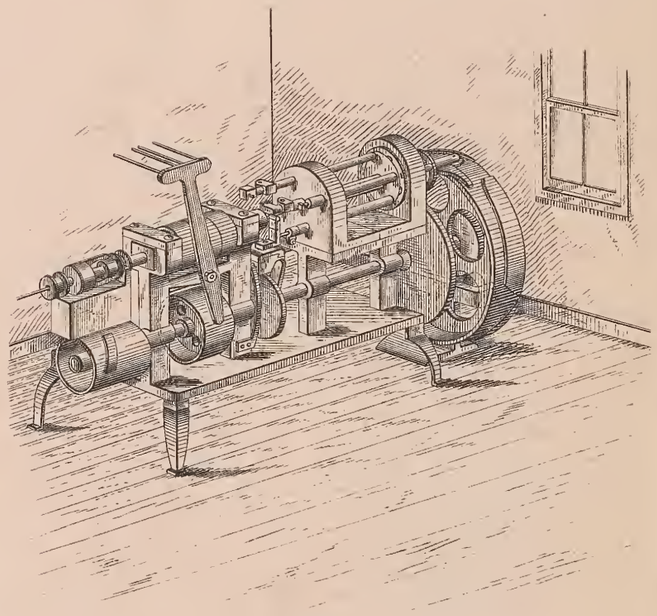
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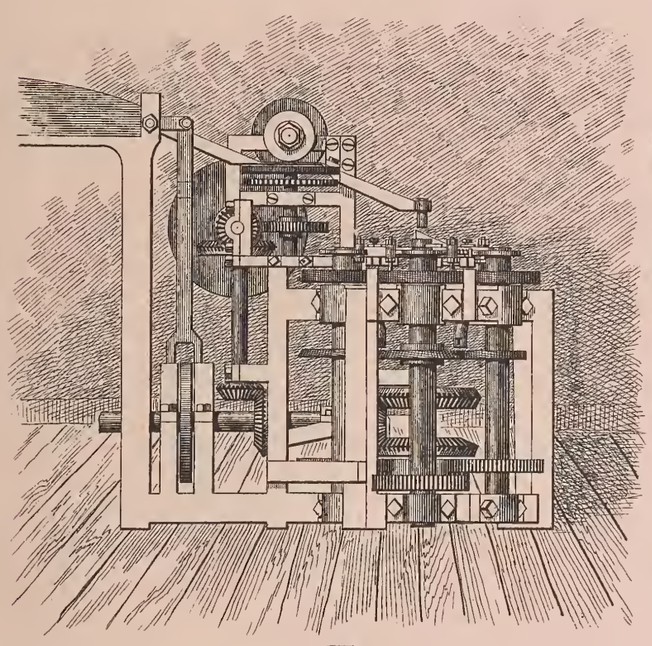
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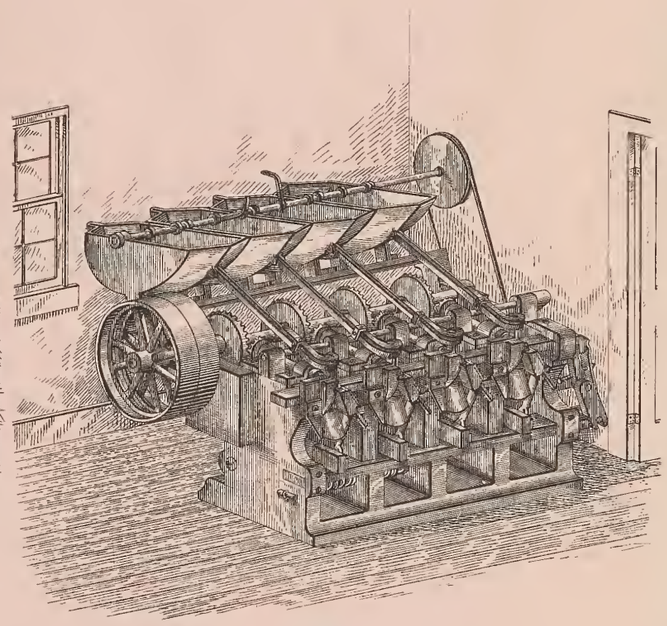
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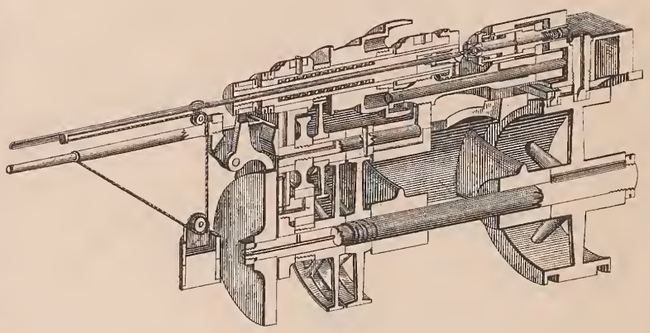
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9

SCREW MAKING MACHINES.

SCREW MAKING MACHINES.

1. U. S. Patent, Nicking Heads—A. D. 1850.
2. " " Reciprocating Dies for forming threads—A.D. 1866.
3. " " Shaving and Nicking—A. D. 1875.
4. " " Cutting Screws from Rods—A. D. 1877.
5. " " Rolling Dies for forming threads—A D. 1880.
6. " " Cutting Screws from Rods—A. D. 1883.
7. " " Rolling Dies for forming threads—A. D. 1883.
8. " " Cutting Screws—A. D. 1883.
9. " " " " from Rods—A. D. 1884.

Screw making is supposed to be of very ancient origin. It is only within the present century, however, that great perfection in this art has been attained.

Wood screws were first made in the United States by machinery, at Providence, R. I., in the year 1834.

The greater portion of the rods from which screws are made comes in coils from Sweden, Germany and England. The rod first passes through a process for removing the flinty scale on the outside, and, after being annealed in furnaces, it is subjected to the pointing process, the purpose of which is to reduce the end of the rod to enter the draw plate. The wire is then drawn in different sizes needed for the great variety of screws. The machinery for the different processes is the result of the skill of many inventors who have produced a system of machines mostly automatic, and beautiful in operation.

By the automatic wire blocks used, if anything happens to the wire while going through the process, the whole apparatus stops. If it did not stop the wire would break. By a machine whose action is accurate the rod is cut into sizes of the screws desired, and the head put on almost at the same instant. The metal, in going through this process, necessarily becomes very oily.

These "blanks," as they are called at this stage, are put into what are called "rattlers," revolving boxes, hexagonal in shape, filled with sawdust, where they are cleansed of the oil that covers them. The blanks are now ready to have their heads shaved, which consists in cutting the heads perfectly round. The blanks are put into a hopper, and by an automatic feeder they are let down into a trough, from which they are picked by a metal finger and put into a spindle. The heads are then shaved, and by a revolving spindle the blank is taken out to the small saw, which cuts the slot in the head. The blank is then revolved back again, and shaved again to get rid of the burr, or rough edge, left by the tool in cutting the slot.

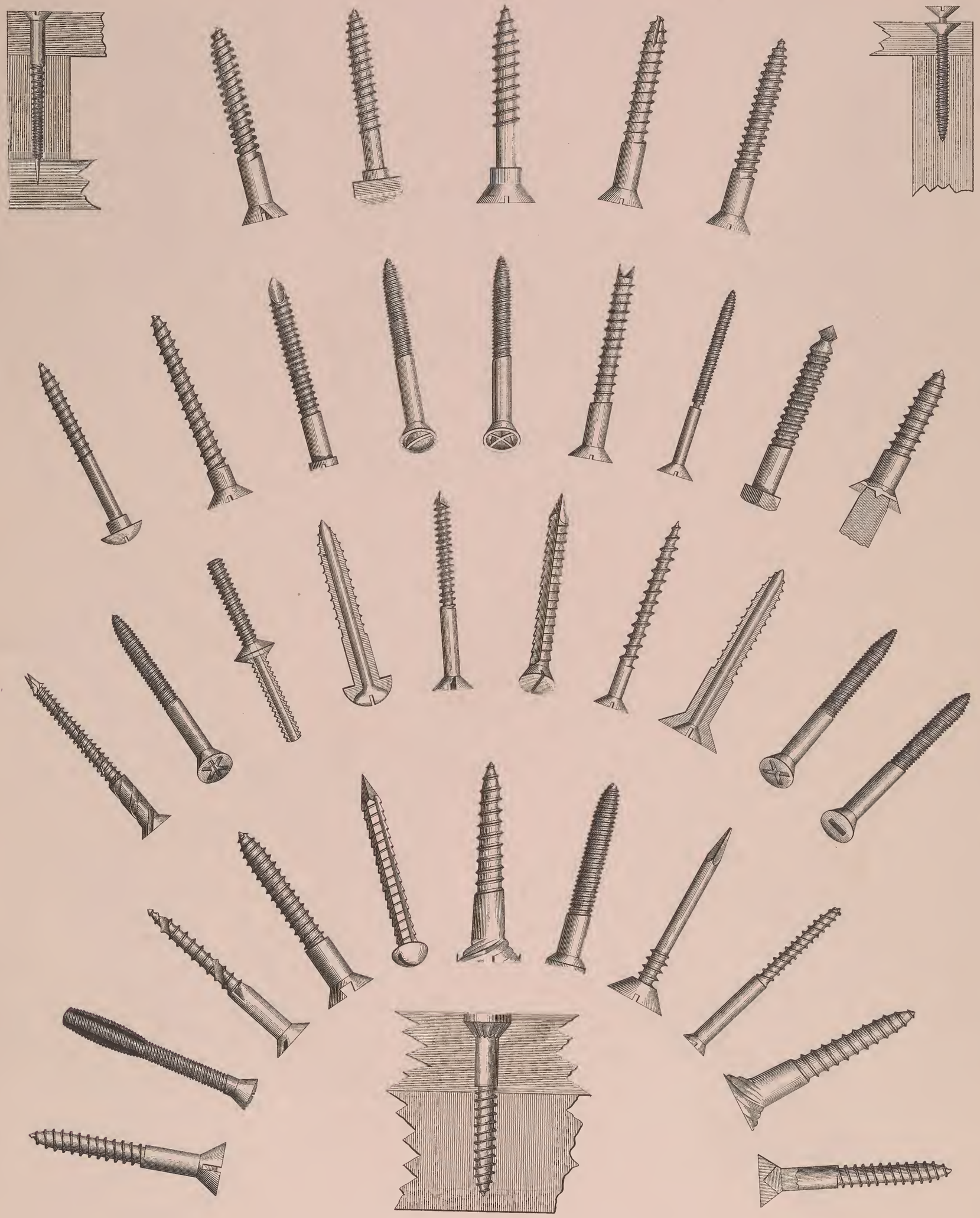
The blanks are then fired out of the machine absolutely perfect. The blanks, after being shaved and slotted, are placed in another machine and threaded, when the screw is complete.

There are machines which can make screws with five hundred threads to the inch, invisible to the naked eye, and it takes 144,000 of them to weigh a pound.

SCREW MAKING MACHINES.

809 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



TYPES OF SCREWS.

SCREWS.

20 Manufactories in the United States.

	1880
Capital Invested,	$4,265,000.00
Value of Productions,	2,184,532.00
Wages Paid,	456,542.00
Hands Employed,	1,585

93 Patents Granted by the United States.

In the year 1809 Ezra L'Hommedieu, of Connecticut, patented a double-podded screw auger, and in the same year informed the Secretary of the Treasury that "he made a machine for himself by which a man, aided by two boys, could make three hundred pounds per day of assorted screws, better than the imported ones, and that, in his opinion, in a short time the demands of the United States would be supplied by screws produced by his simple and cheap process."

Not only have improvements been made in machines for producing screws, but also in the shape and method of construction of the screw itself.

One of the chief improvements is the gimlet-pointed screw, which has almost superseded the old form of the screw ending in a blunt point.

It is singular that so simple an improvement as this, which is simply combining the screw point of the gimlet with the screw itself, should have been so recently made.

Screws and gimlets had both been long in use before the idea of combining them occurred to any one of the thousands daily engaged in the practical use of both, and this, too, when the gimlet itself was only a pointed screw.

In France gimlet-pointed screws were made over a hundred years ago, but, from the want of a simple change in the machinery used for making them, they did not possess the accuracy needed for bringing them into use.

Another late improvement in screws consists in the arrangement of the threads about the center cylinder. This differs from the ordinary screw in having three threads, which revolve about the core only once and a half in their passage from the top to the point, instead of having only one thread, which revolves many times in the same distance.

The advantage claimed of having the threads revolve at the angle is, that a screw so constructed can be driven in with a hammer instead of requiring the screw driver; also, that the threads are farther apart and take a stronger hold upon the wood, and hold with double the strength of an ordinary screw.

Some of the screws used in making watches at the Waltham Watch Manufactory are so minute as to seem like iron filings or grains of ground pepper.

A pound of steel, costing but fifty cents a pound, yields 100,000 of these screws, worth eleven dollars.

SCREWS.

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U. S. PATENTS

FROM

A. D. 1831

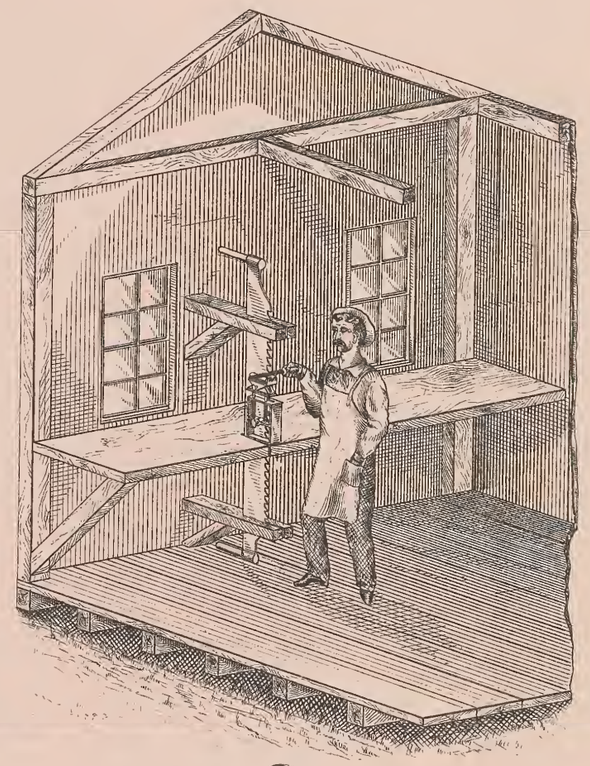
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A. D. 1884.

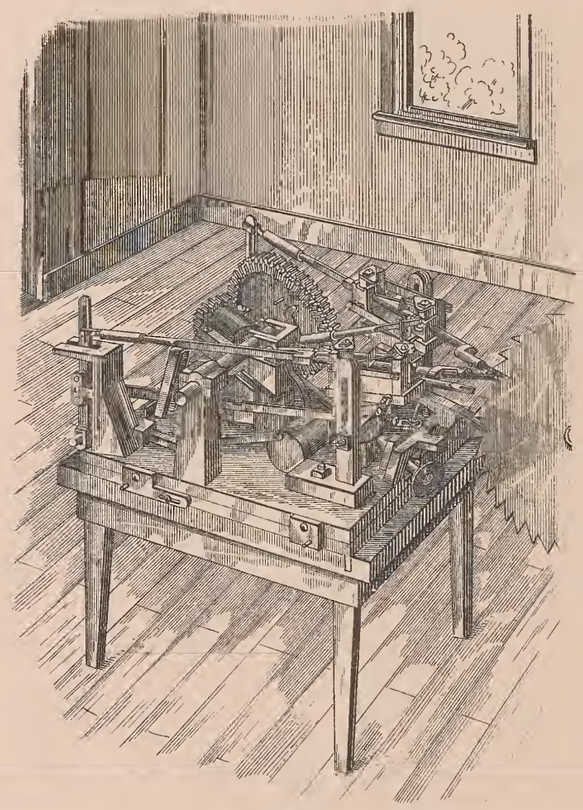
Sackett & Wilhelms Litho Co New York



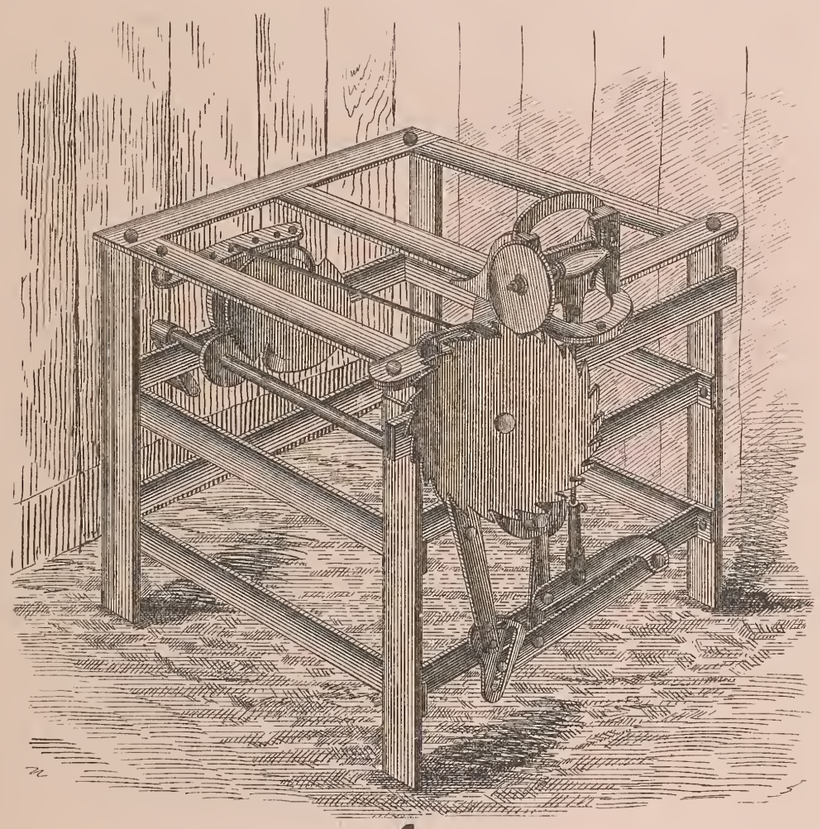
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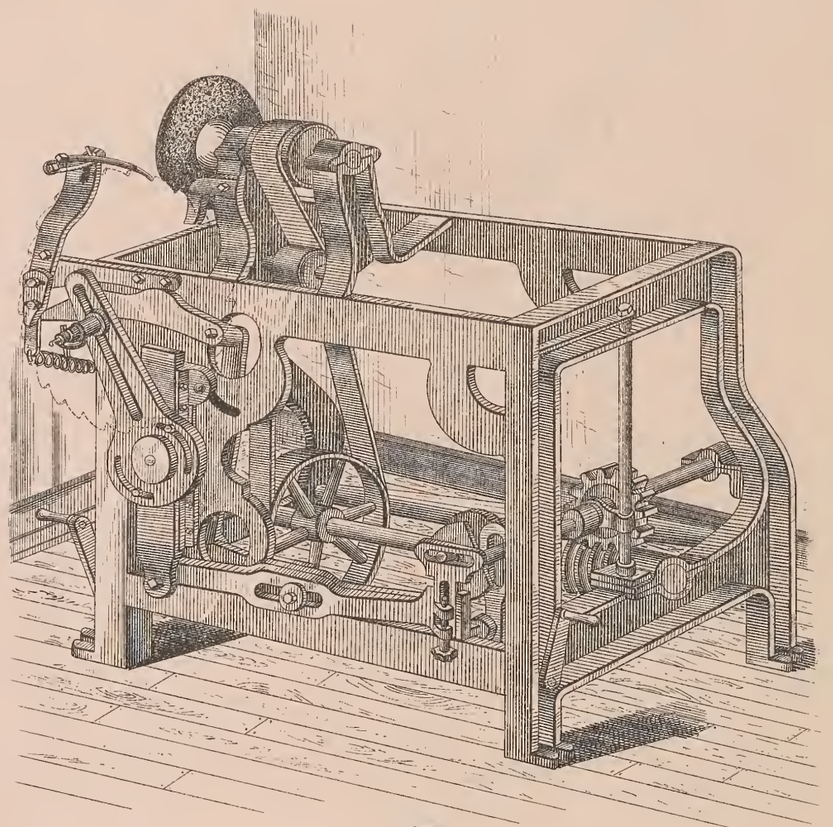
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SAW SHARPENING MACHINES.

SAW SHARPENING MACHINES.

No. 1. Primitive Hand Filing.

2. U. S. Patent, Saw Sharpener—A. D. 1849.

3. " " Reciprocating Sharpener—A. D. 1878.

4. " " Rotary Sharpener—A. D. 1879.

5. " " " " —A. D. 1884.

Pliny, A. D. 79, says that green wood fills the intervals between the teeth of the saw with sawdust, rendering its edge uniform and inert, and it is for this reason that the teeth are made to project right and left in turns, so that the sawdust is discharged.

Saw grinding machines were among those supplied by Sir Samuel Bentham to the British Admiralty before 1800.

The angles at the points of saw teeth are, in general, more acute in proportion to the softness of the material to be operated on, varying from 90° for metals and very hard woods to 60° or less for soft woods.

To insure the action of each tooth the points must be in the same straight line (in rectilinear saws), and for this purpose they are topped by laying the file without its handle flatwise upon the points and reducing them to the same level by a few strokes of the tool.

More force is applied to the file in sharpening the teeth near the ends of the saw than at the middle, where they are more worn.

Hand-saw teeth and other teeth having angles of 60° are sharpened by first filing the oblique faces next the backs, then the other oblique faces, and their backs.

Wood pruning saws, which are made thicker on the face than at the back, are sharpened by a triangular file applied very obliquely in a horizontal direction, sometimes at an angle exceeding 45°.

The setting of the saw is afterward performed.

SAW SHARPENING MACHINES.

787 Patents Granted by the United States.

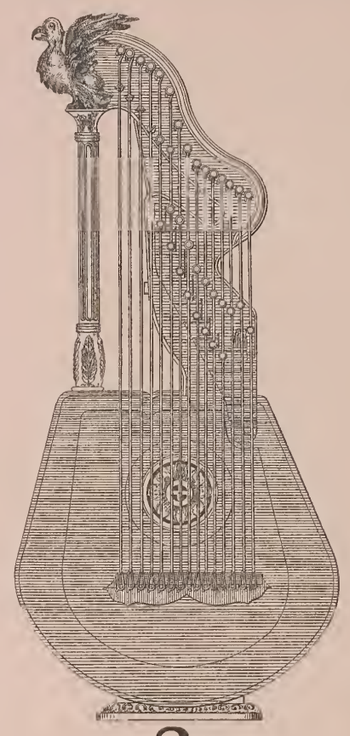
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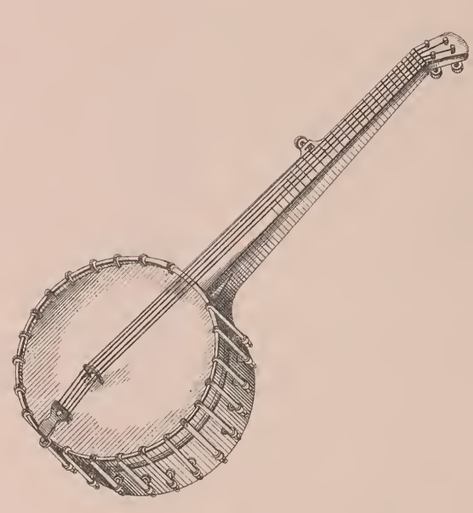
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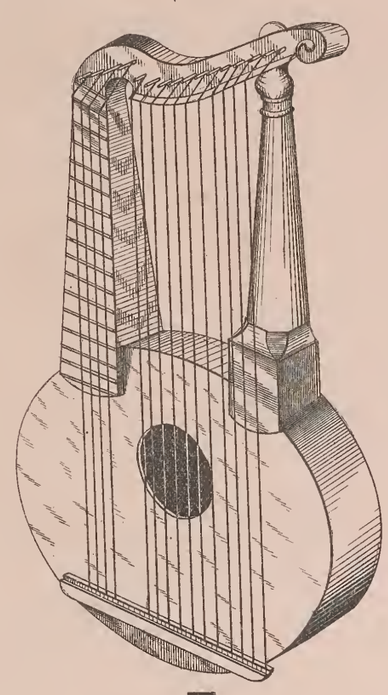
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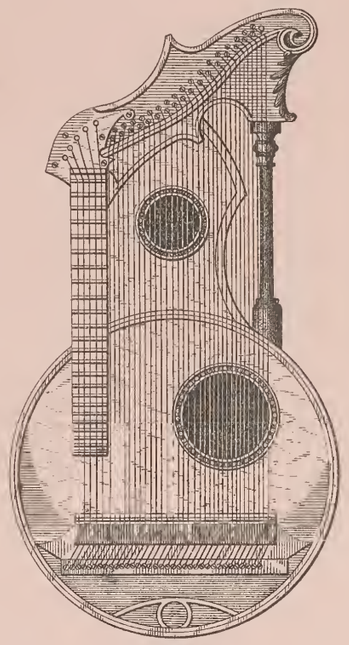
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9

BANJOS AND GUITARS.

BANJOS AND GUITARS.

No. 1. Ancient Citheras.
2. Spanish Guitar.
3. English Harp Lute—A. D. 1816.
4. U. S. Patent, Harp Guitar—A. D. 1831.
5. " " Pedal " —A. D. 1873.
6. " " Banjo—A. D. 1876.
7. " " Guitar—A. D. 1881.
8. " " Zither—A. D. 1883.
9. " " Guitar Head—A. D. 1884.

The banjo is a modern invention. It is much esteemed by the Negroes of the southern United States.

Its capacity is limited to the performance of simple tunes, and it is principally used for accompaniments.

The thrumming sound has a near resemblance to the Tam Tam of Africa and the Orient.

The guitar was known for more than fifteen centuries before the Christian era.

In the sculptures of Nimrod a musician is represented playing on a guitar.

Europeans derived it from Egypt through the intervention of the Saracens, after the lull of the dark ages, following the track through Spain.

The modern Arabs have an instrument which may be considered the Syrian guitar. The head is bent over, as in the European. the neck appears to be destitute of frets, the strings are seven, and made of catgut.

The guitar was introduced into England by Francis Corbeta, about 1660.

The guitar is the principal musical instrument of the Japanese. Their syanisie has three strings, two in the octave, the middle one giving the fifth.

The Spanish guitar has a hollow body with a round opening in the sounding board. The strings are six, and are stretched between a bar attached to the sounding board and the pegs, which are journaled in the head.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900.00	$14,446,765.00
Value of Productions,	6,548,432.00	19,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

BANJOS AND GUITARS.

84 Manufactories of Miscellaneous Musical Instruments in the United States.

Capital Invested,	$654,850.00
Value of Productions,	853,746.00
Wages Paid,	293,062.00
Hands Employed,	573

69 Patents Granted by the United States.

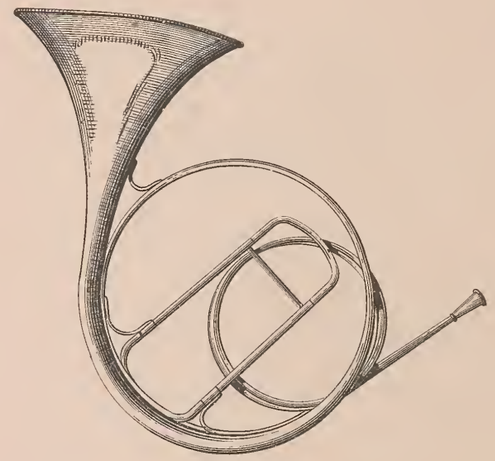
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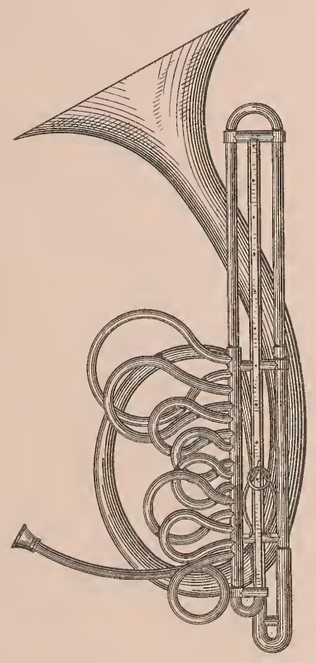
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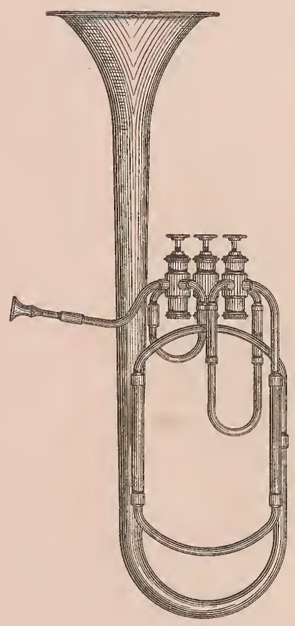
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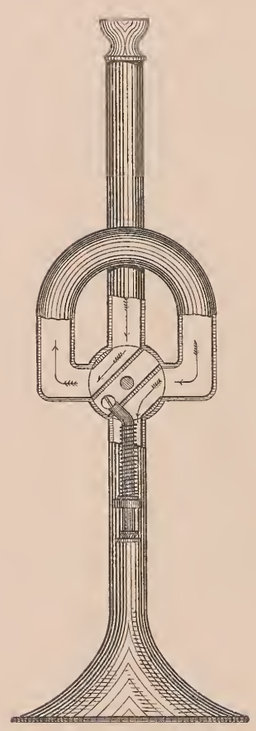
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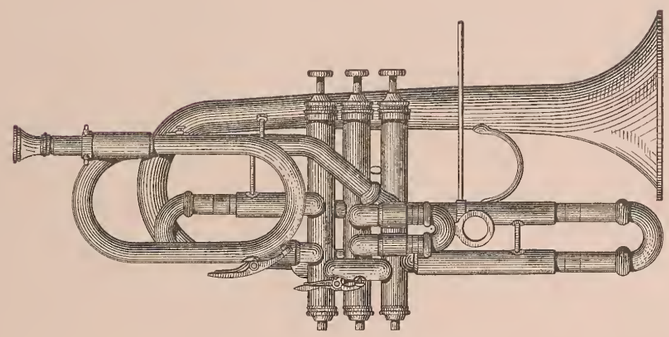
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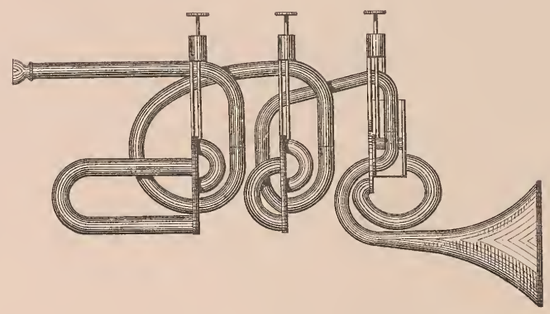
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CORNETS.

CORNETS.

No. 1. Ancient Trumpet.
2. Hunting Horn.
3. French Horn.
4. " Cornet—A. D. 1818.
5. " Saxhorn—A. D. 1845.
6. U. S. Patent. Cornet Attachments—A. D. 1848.
7. " " Cornet—A. D. 1878.
8. " " " —A. D. 1884.

The cornu of the ancient Romans, like the instruments mentioned in the Bible, (Leviticus xxv, 9.) was curved and formed from a horn. It was afterwards made of metal. Its invention is credited to the Etruscans. It differed from the tibia in being larger, and from the tuba in being curved and without keys.

The modern cornet is a metallic wind instrument, resembling a trumpet.

The cornet-a-piston is generally made of brass, has two or three valves, and in brass bands takes the soprano and contralto parts. It was first introduced in France. Its tones are less powerful, but far more easily manageable than those of the trumpet.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900.00	$14,446,765.00
Value of Productions,	6,548,432.00	19,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

CORNETS.

84 Manufactories of Miscellaneous Musical Instruments in the United States.

Capital Invested,	$654,850.00
Value of Productions,	853,746.00
Wages Paid,	293,062.00
Hands Employed,	573

55 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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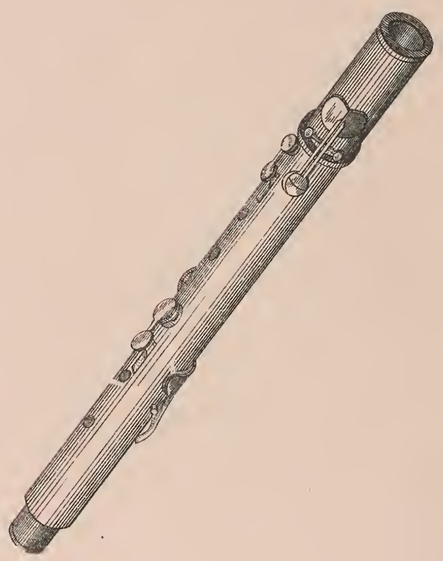
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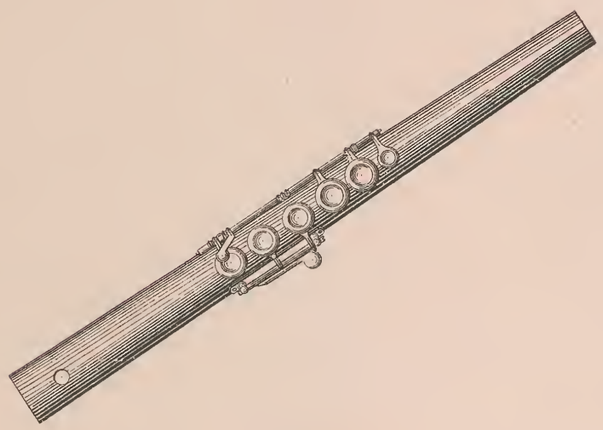
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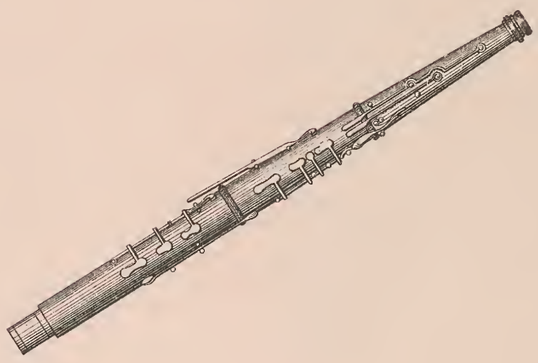
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FLUTES.

FLUTES.

No. 1. Flute á Bec.
2. Double.
3. German.
4. Eight Keyed.
5. Boehm Tube.
6. " 1832.
7. U. S. Patent,—A. D. 1849.
8. " " —A. D. 1868.
9. " " —A. D. 1876.

The Flute, in various forms, has been in use about 4,000 years.

The flute mentioned in the book of Daniel may have been used in Egypt, as paintings of flutes are common on Egyptian tombs.

The flutes of the Egyptians were single and double.

Herodotus, 450 B. C., mentions "marching of troops to the sound of flutes." The Classic Greeks made flutes of asses' bones.

The Alexandrians were specially skilled in the use of the flute. There was much written on flutes 2,000 years ago. They are extensively made and used by the natives of Brazil, and the Peruvians have them of various sizes.

The flute known to us is the German flute.

Juba says "flutes made of the leg bones of the kid were invented by the Thebans.

Until the early part of the eighteenth century it retained the form of a pipe, and was called the English flute.

Theobald Bohm invented, in 1833, a flute known as the Bohm flute, which is said to combine improvements in nearly every part of the instrument, and is now generally adopted.

Flutes are made of hard wood, ivory, glass, metal and vulcanized rubber.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900 00	$14,446,765.00
Value of Productions,	6,548,432.00	19,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

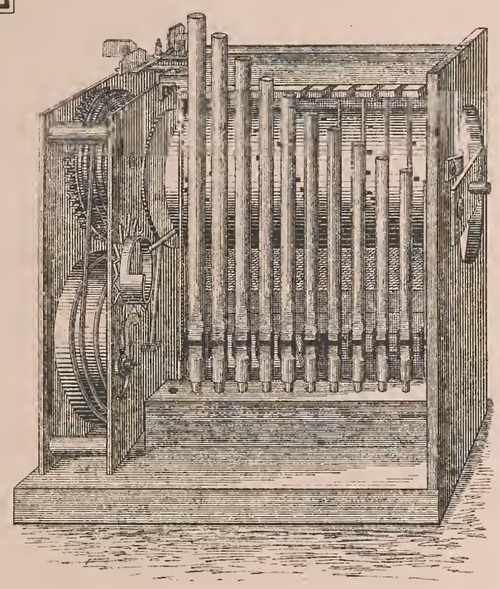
FLUTES.

64 Manufactories of Miscellaneous Musical Instruments in the United States.

Capital Invested,	$654,850.00
Value of Productions,	853,746.00
Wages Paid,	293,062.00
Hands Employed,	573

17 Patents Granted by the United States.

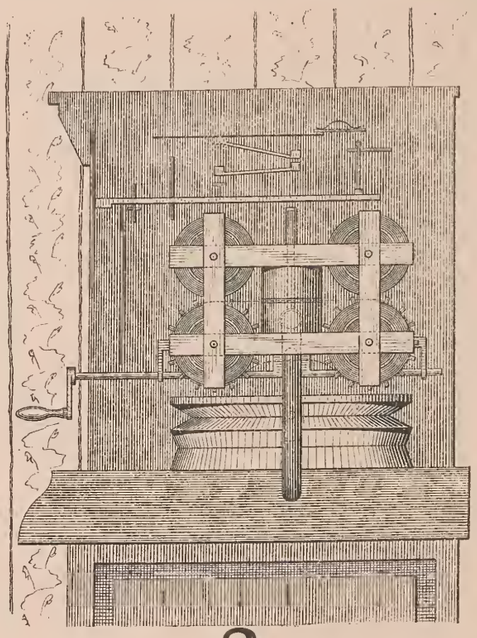
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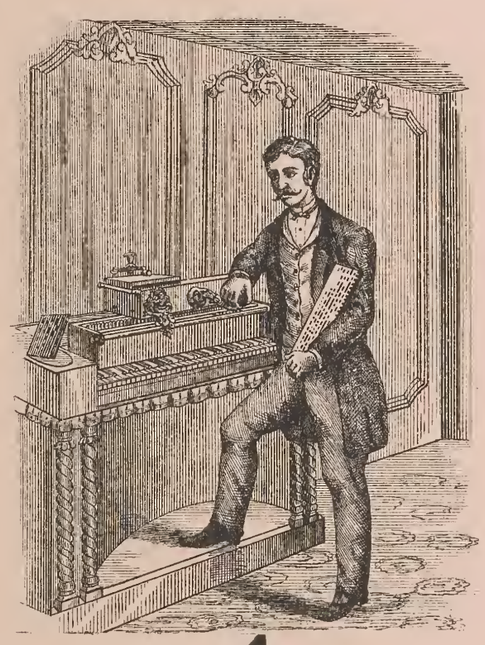
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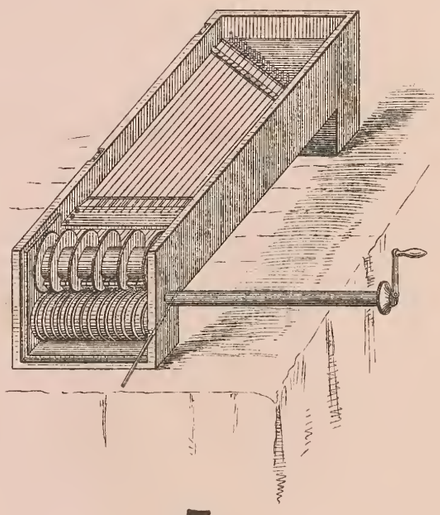
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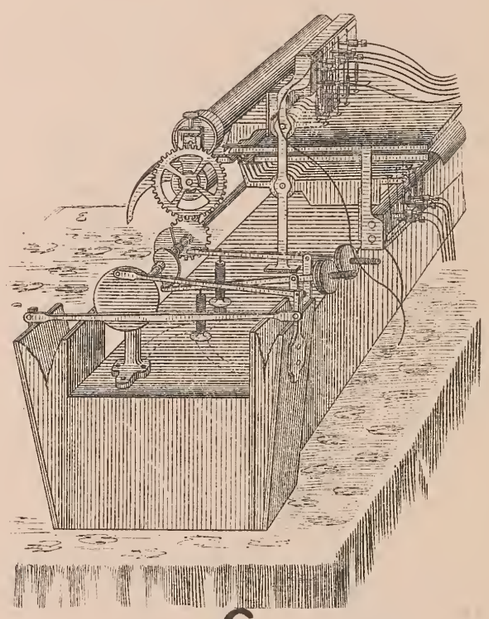
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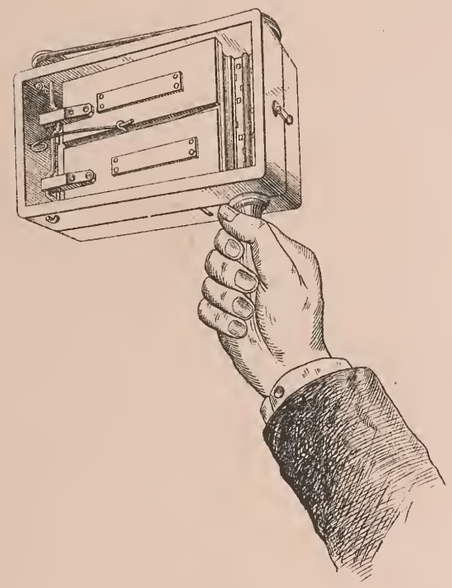
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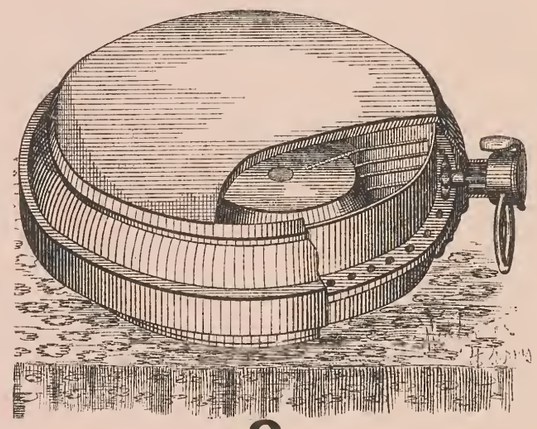
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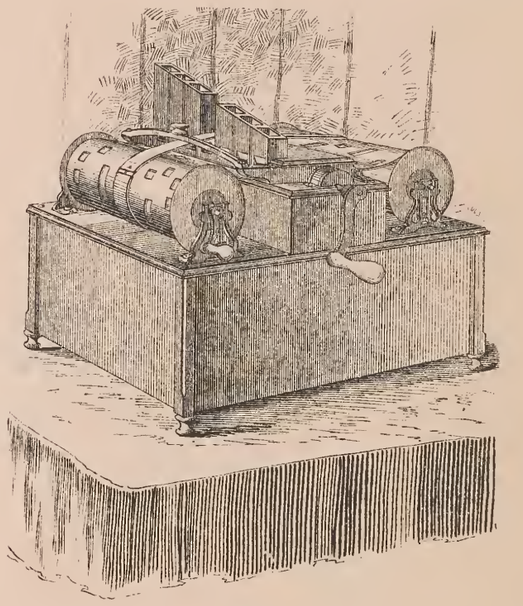
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MUSIC BOXES.

MUSIC BOXES.

No. 1. Barrel Organ, 18th Century.
2. Sheet Organ.
3. French Organ—A. D. 1842.
4. English—A. D. 1846.
5. U. S. Patent, Self Acting—A. D. 1849.
6. " " Electro Pneumatic—A. D. 1877.
7. " " Mechanical—A. D. 1879.
8. " " Watch Box—A. D. 1881.
9. " " Mechanical—A. D. 1882.

The use of machines for making mechanical music is almost coeval with the invention of clocks.

The principle of their mechanism is almost the same as that of the barrel or hand organ, and of the machinery used for chimes of bells in church towers.

Music boxes proper were not introduced much before the 18th century.

Among the earliest made were small ones, to be worn as charms pendent from a watch chain, and from this insignificant beginning has grown the modern music box, capable of almost every musical effect, and of playing from one to more than one hundred tunes. The principal parts of the mechanism are the comb, the cylinder, and the fly or regulator.

Various attachments or accompaniments, such as bells, drums and castanets, are often applied, and different effects are produced according to the arrangement of the music.

In respect to these effects, music boxes are called mandolines, expressives, quatuors, organocleeds, piccolos, &c. Some have a combination of reeds and pipes, and are called flutes, celestial voices or harmoniphones.

The musical boxes of Prague and Ste. Susanne, in France, are largely exported.

The centers of the manufacture in its present state of mechanical perfection, are Geneva and Ste. Croix, in the Pays de Vaud, Switzerland.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900.00	$14,446,765.00
Value of Productions,	6,548,432.00	10,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

MUSIC BOXES.

94 Manufactories of Miscellaneous Musical Instruments in the United States.

Capital Invested,	$654,850.00
Value of Productions,	853,746.00
Wages Paid,	293,062.00
Hands Employed,	573

202 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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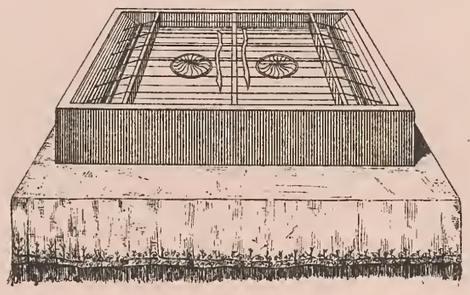
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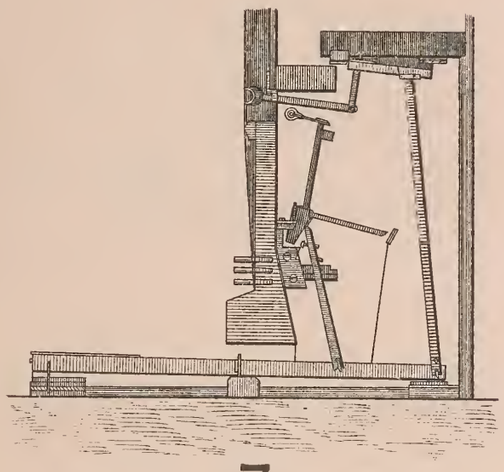
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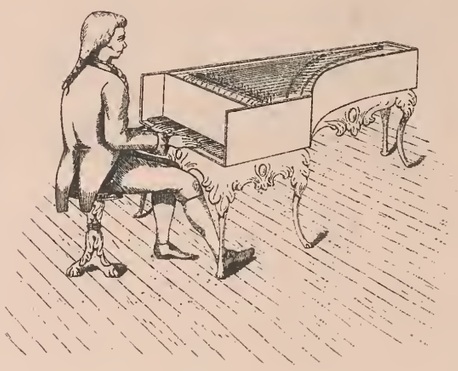
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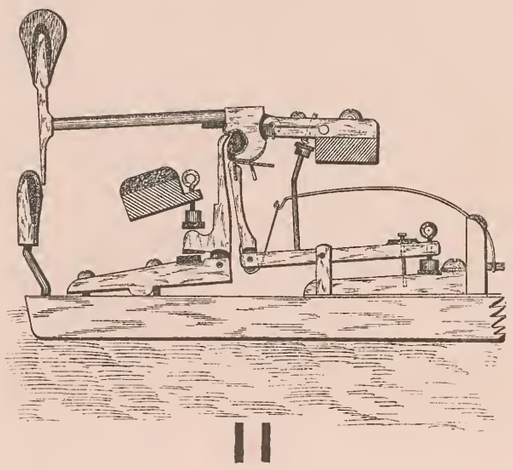
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12

PIANOS.

PIANOS.

No. 1. Ancient Lyre.
2. " Harp.
3. " Dulcimer.
4. " Psalterium.
5. Citole, 13th Century.
6. Virginal, 16th Century.
7. English Upright—A. D. 1795.
8. Spinnet—A. D. 1815.
9. Harpsichord—A. D. 1820.
10. U. S. Patent, Square—A. D. 1884.
11. " " Piano Action—A. D. 1884.
12. " " —A. D. 1884.

The first marked approach to the piano-forte appears in the transition from the dulcimer to the keyed cithern, a small, oblong box, holding a series of strings in triangular form, and struck by plectra of quills attached to the inner ends of the keys. This application of the keyboard to stringed instruments is believed to have been first made in the twelfth century.

An improvement on the keyed cithern, called a virginal, was very popular with Queen Elizabeth and the ladies of her time. The first piano was made by Christofali, of Padua, in 1711. In 1716, Marius, a French maker of harpsichords, submitted four forms of instruments "of which he claimed to be the inventor, termed by him hammer harpsichords." Christopher Schroter, in 1717, asserted that he had invented an arrangement of keys, springs and hammers, and stated that "on this instrument he could play at pleasure, forte or piano." This is believed to have suggested the name "piano-forte."

Plenius refers to "forte-pianos" in 1741.

Pedals were introduced about the middle of the eighteenth century, and buff leather was substituted for quills in 1741.

The first piano known in England was made by an English monk, about 1757, at Rome.

The piano was introduced on the stage of Covent Garden Theatre, London, May 16, 1767, as "a new instrument." From this time its success was assured.

Zumpe made large numbers of pianos in England, in 1776.

Bach played upon a "forte-piano" in the palace of Frederick the Great, at Potsdam.

The first upright piano was patented in 1795, by Wm. Stodart.

Few attempts were made at piano making in the United States until the present century.

Jonas Chickering, the founder of the firm of Chickering & Sons, of Boston and New York, has been called the fdther of the business in this country. He began to manufacture pianos in 1823, and exposed his first instrument for sale on April 15 of that year.

The iron frame and overstrung scale are the two most prominent features in improvements on pianos in America.

Fifteen kinds of wood are used in the ordinary piano.

There were manufactured in the United States, in 1829, 2,500 pianos, of the aggregate value of $75,000. About 15,000 are manufactured yearly in New York alone. The United States now far outstrips Europe in the manufacture of pianos, and possesses the largest establishments in the world.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900.00	$14,446,765.00
Value of Productions,	6,548,432.00	19,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

PIANOS.

174 Manufactories in the United States.

Capital Invested,	$9,869,577.00
Value of Productions,	12,264,521.00
Wages Paid,	4,663,193.00
Hands Employed,	6,575

730 Patents Granted by the United States.

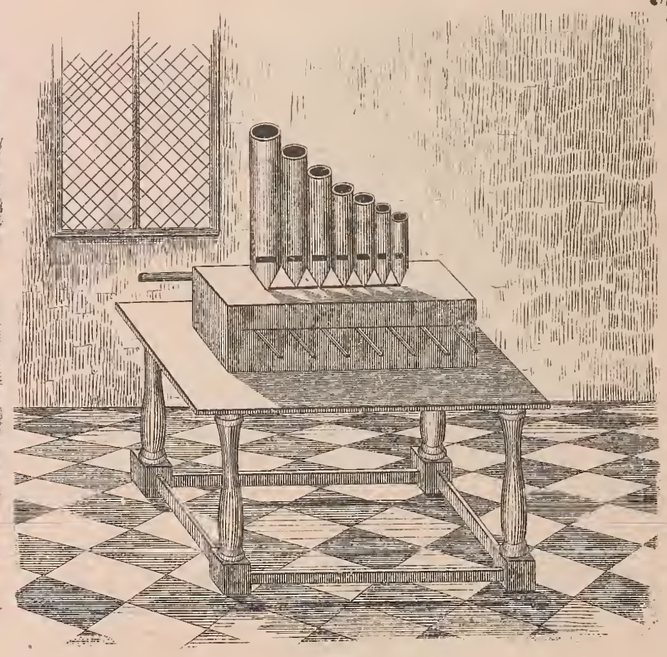
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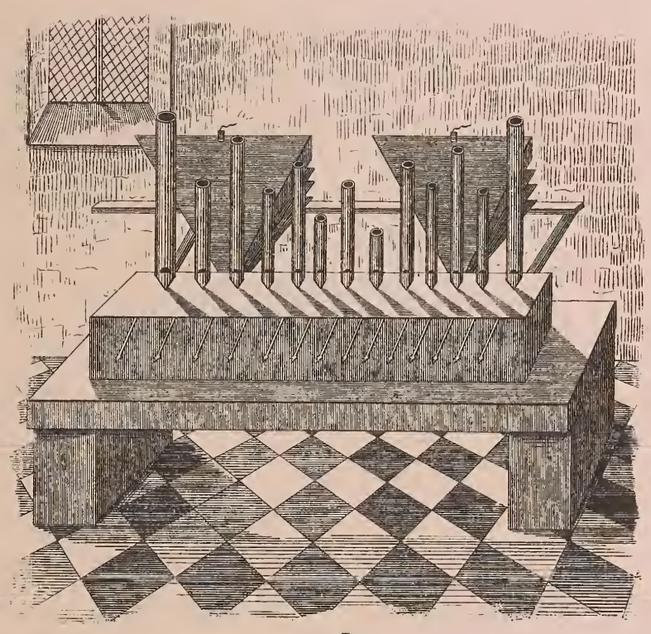
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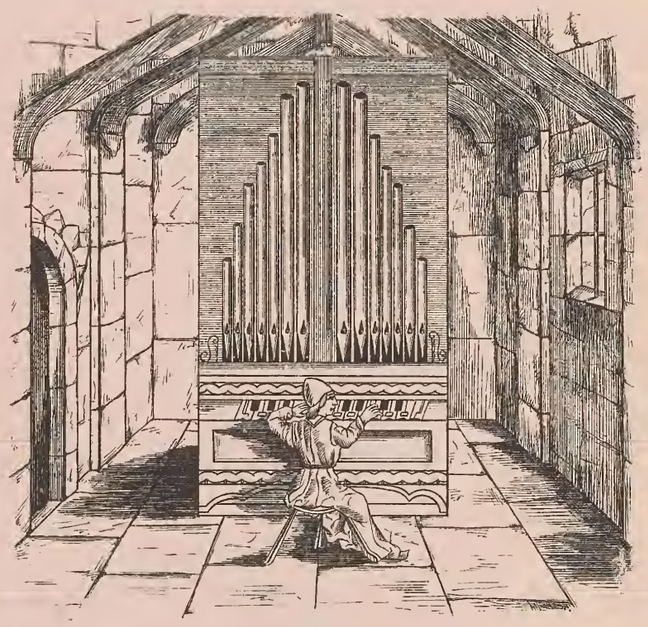
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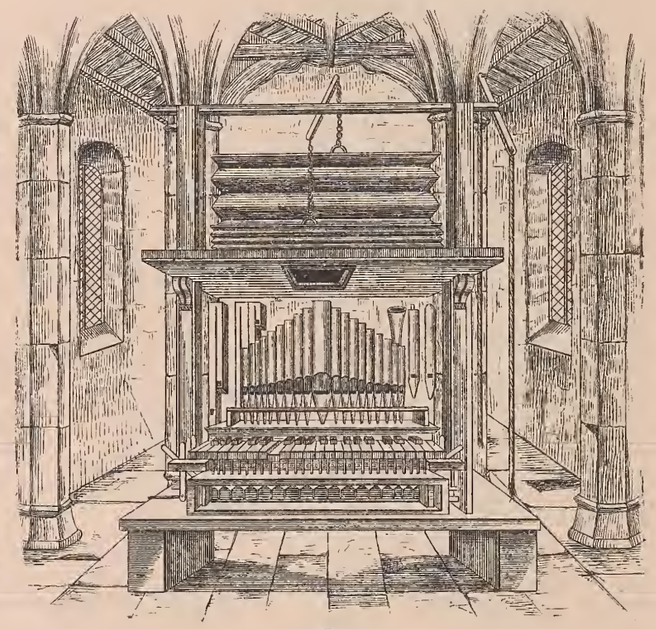
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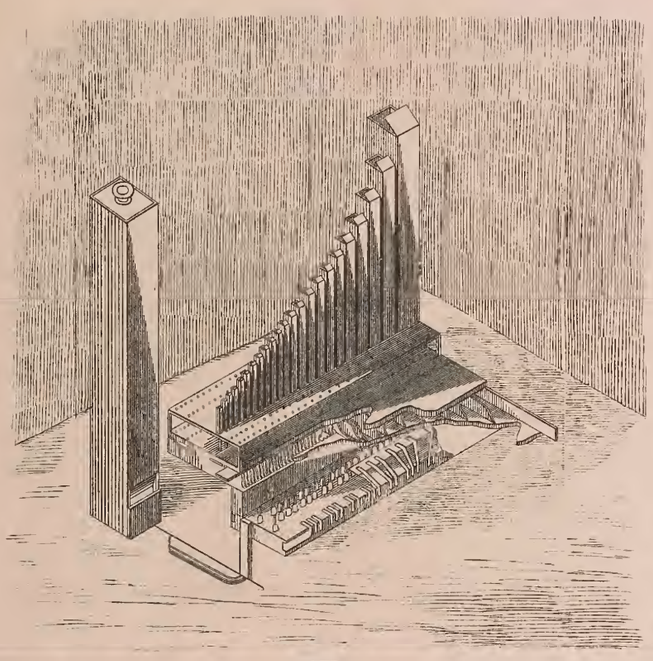
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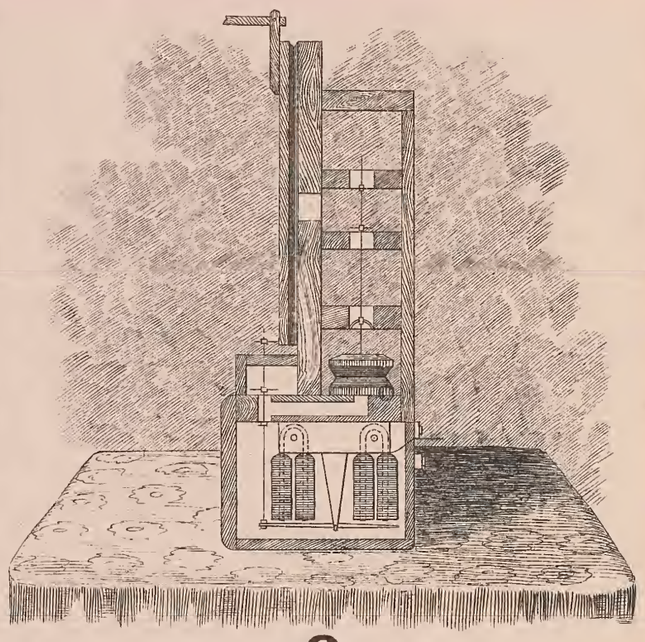
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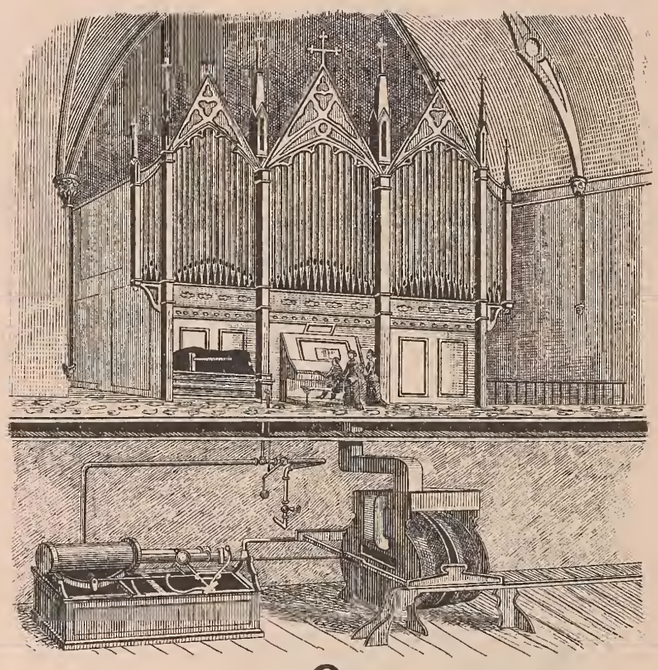
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9

PIPE ORGANS.

PIPE ORGANS.

No. 1. Primitive Shepherd's Pipe.
2. " Pandean Pipes.
3. " Valves.
4. " Bellows.
5. " Key Board, 11th Century.
6. " Organ, 12th Century.
7. U. S. Patent, Organ—A. D. 1838.
8. " " Electro Pneumatic Stop—A. D. 1868.
9. " " Organ Blower—A. D. 1876.

The early history of the organ is very obscure. A plausible supposition is that the instrument may have been suggested by some modification of the Pandean pipes. The organ mentioned in Genesis iv. 21, was probably identical with the syronix or pipe of Pan.

Ctesibius is said to have invented an hydraulic organ about the third century B. C.

An organ is described as carved on an ancient monument, and in the Mattei Gardens at Rome, the form, the operation of the keys and the bellows of which closely resemble those of the present day.

Organs were common in England in the tenth century.

Pedals, or foot keys, were added to the organ by Bernhard, a German, in 1470.

An organ built in 1733, for a church at Pisa, has four rows of keys and more than 100 stops. The organ at Seville Cathedral has 100 stops and 5,300 pipes.

Organ pipes vary in length from three-quarters of an inch to thirty-two feet.

The mechanism by which pneumatic power could be applied to organs, making the action of the largest organ as light as that of a piano forte, was first made fully known in 1840, by Mr. Barker, an Englishman.

The Pandean pipe yet survives in England, as an accessory to the exercises of Punch and Judy, playing the air to a base drum accompaniment.

The largest organ in the world was built by Henry Willis, in 1870, and is in Albert Memorial Hall, London. It has 138 stops, 4 manuals, and nearly 10,000 metal pipes.

One of the largest organs in America is in Boston, Mass. It has 89 stops, 4 manuals, and 4,000 pipes.

The fourth largest in the world, and the largest in the United States, is the one erected in the Music Hall at Cincinnati, Ohio, in 1878. It has 96 stops and 6,237 pipes.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900.00	$14,446,765.00
Value of Productions,	6,548,432.00	19,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

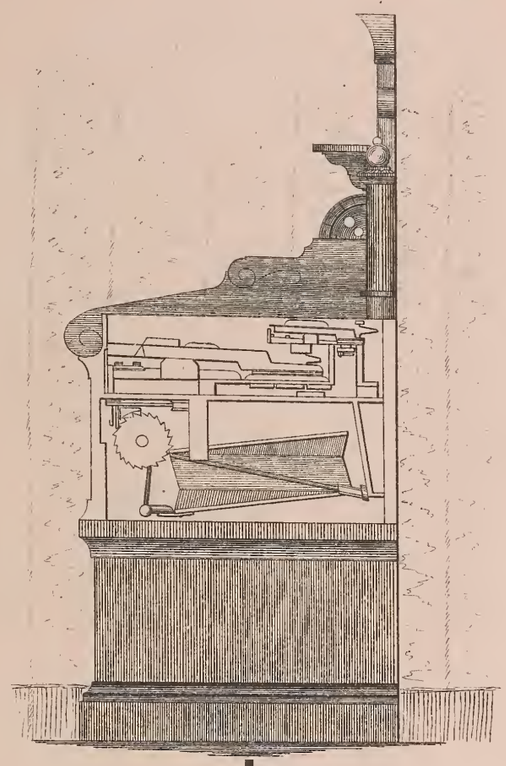
PIPE ORGANS.

171 Manufactories of Organs in the United States.

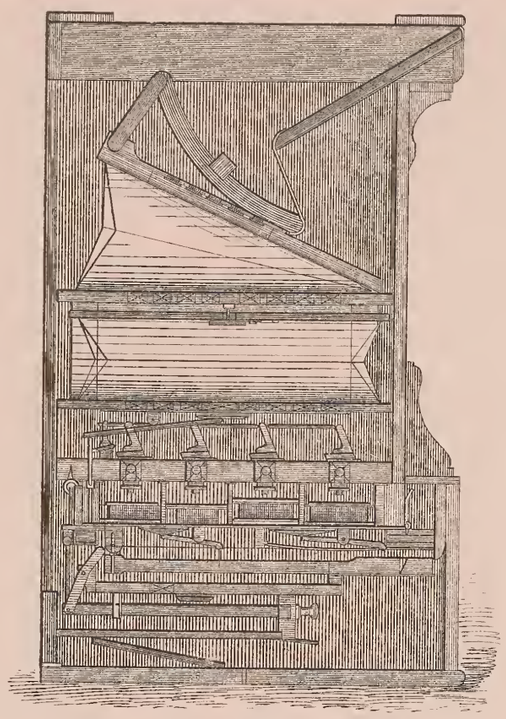
Capital Invested,	$3,922,338.00
Value of Productions,	6,136,472.00
Wages Paid,	2,142,539.00
Hands Employed,	4,202

179 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



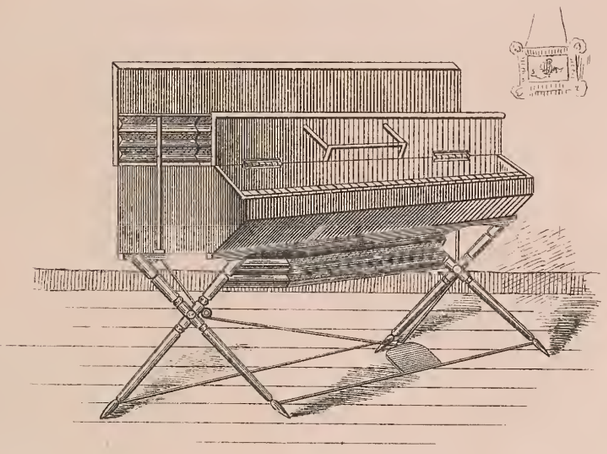
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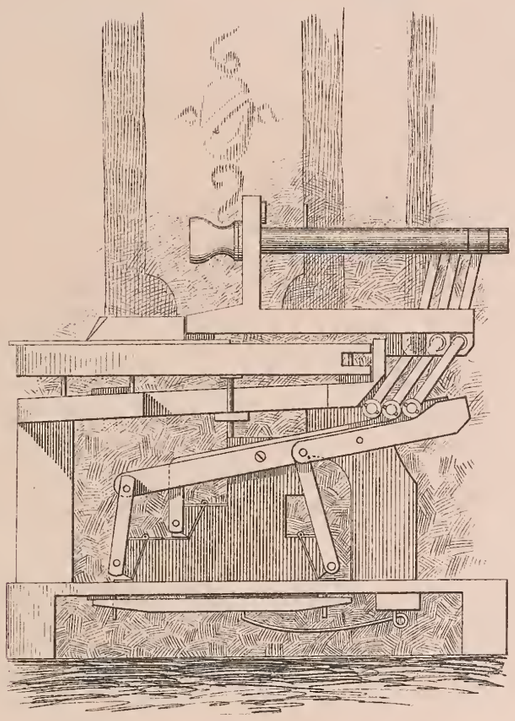
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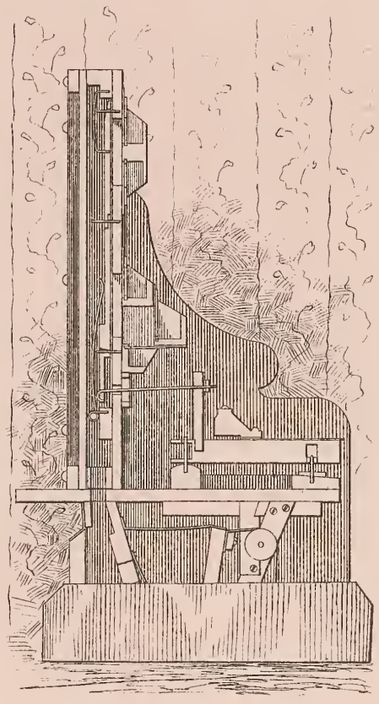
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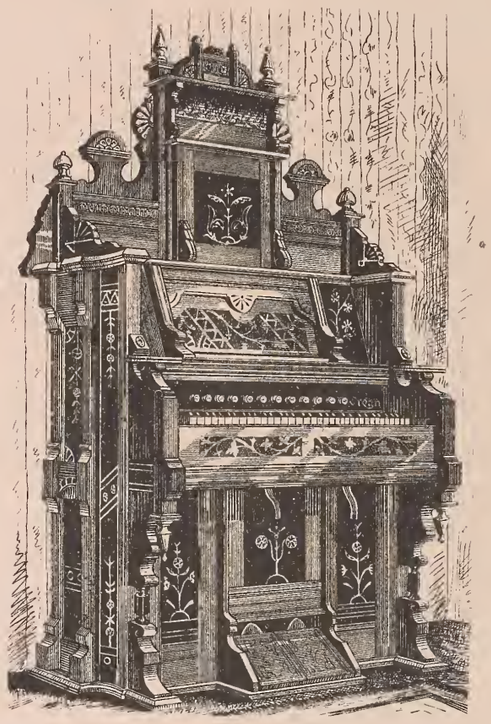
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REED ORGANS.

REED ORGANS.

No. 1. Aolen, English—A. D. 1829.
2. Harmonicum—A. D. 1840.
3. U. S. Patent, Exhaust—A. D. 1846.
4. " " Reed—A. D. 1867.
5. " " Cabinet—A. D. 1872.
6. " " Stop Action—A. D. 1877.
7. " " " " —A. D. 1884.
8. " " Parlor—A. D. 1884.

The invention of the reed organ is attributed to the Greeks, and a description of one being blown by bellows and played by keys is given in a Greek epigram in the Anthologia, attributed to the Emperor Julian, in 364, translated as follows: "I see reeds of a new species, the growth of another and a brazen soil, agitated by a blast rushing from a leathern cavern beneath their roots, and producing melodious sounds as the keys dance under the skilful fingers of a robust performer."

The first organ in the western part of Europe was that sent from Constantinople, by Constantine IV, to King Pepin, in 757.

The period when this instrument was introduced into churches is involved in considerable obscurity, though there is little doubt that the Greeks set the example.

The first United States patent for a reed organ was granted in 1812, and the first were made and introduced in the United States in the year 1818.

At the Paris exposition, 1855, American reed organs created a great sensation for their perfection in tone, workmanship, &c.

MUSICAL INSTRUMENTS.

429 Manufactories in the United States.

	1860	1880
Capital Invested,	$4,431,900.00	$14,446,765.00
Value of Productions,	6,548,432.00	19,254,739.00
Wages Paid,	2,378,520.00	7,098,794.00
Hands Employed,	4,461	11,350

SUB CLASS.

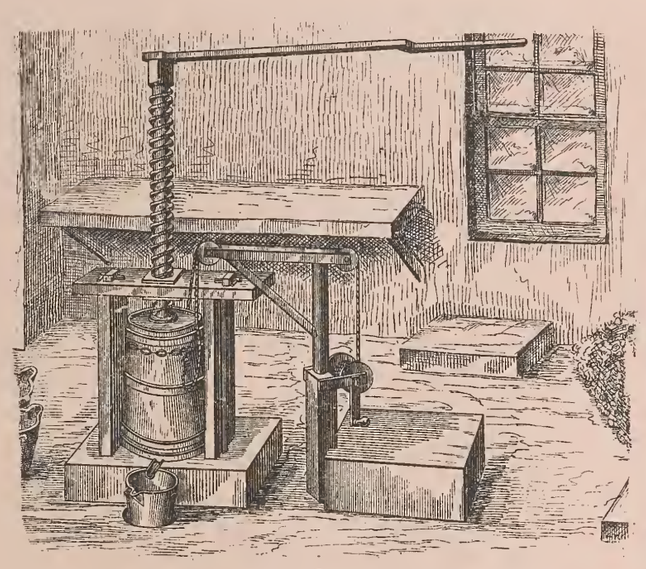
REED ORGANS.

171 Manufactories of Organs in the United States.

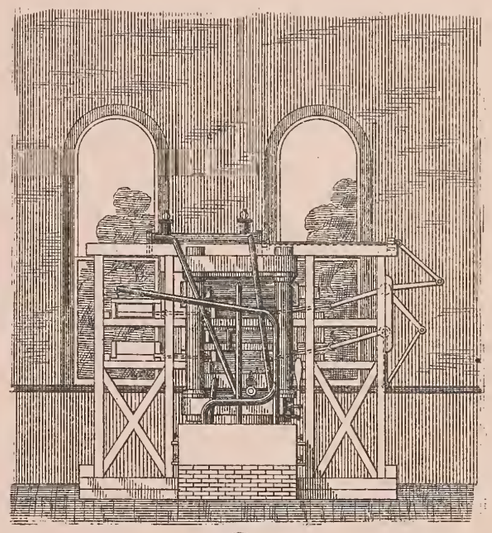
Capital Invested,	$3,922,338.00
Value of Productions,	6,136,472.00
Wages Paid,	2,142,539.00
Hands Employed,	4,202

305 Patents Granted by the United States.

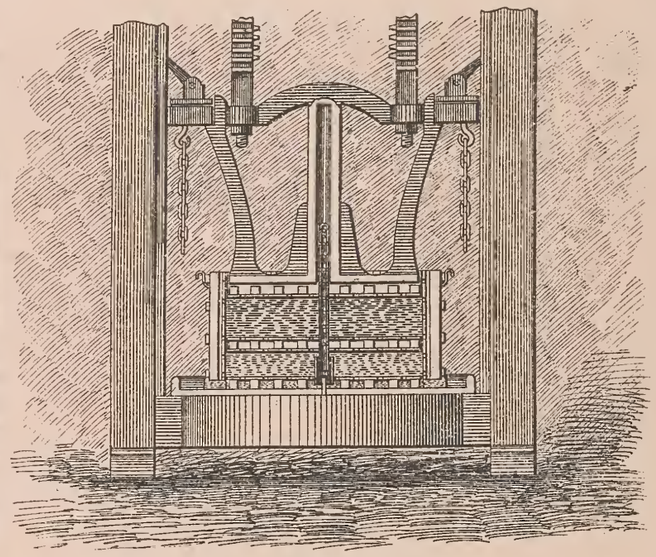
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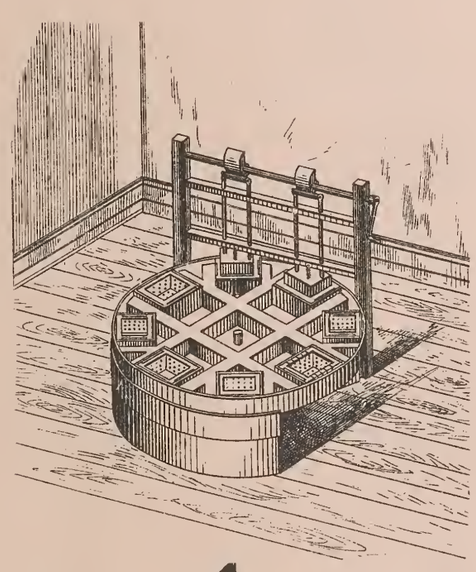
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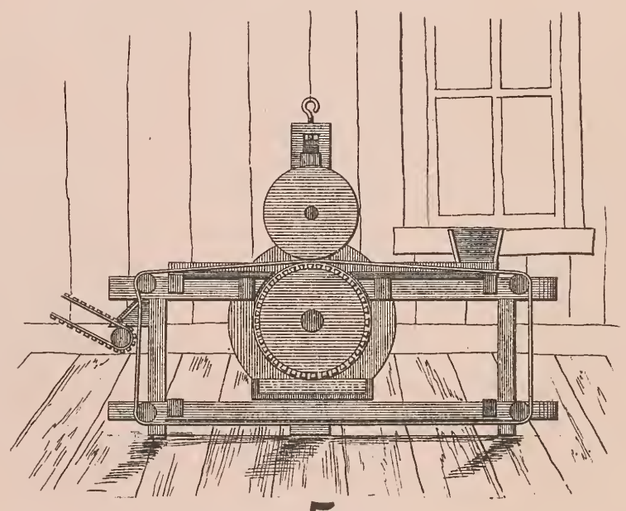
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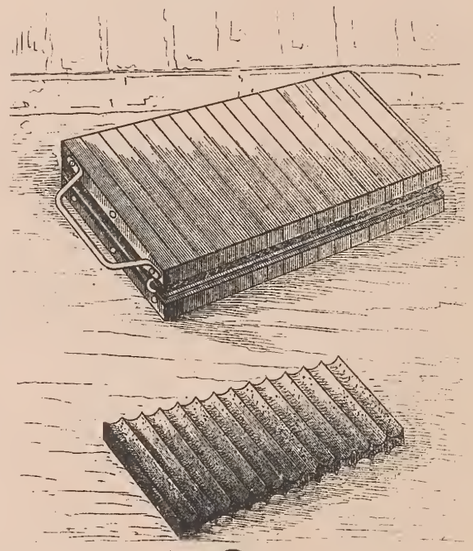
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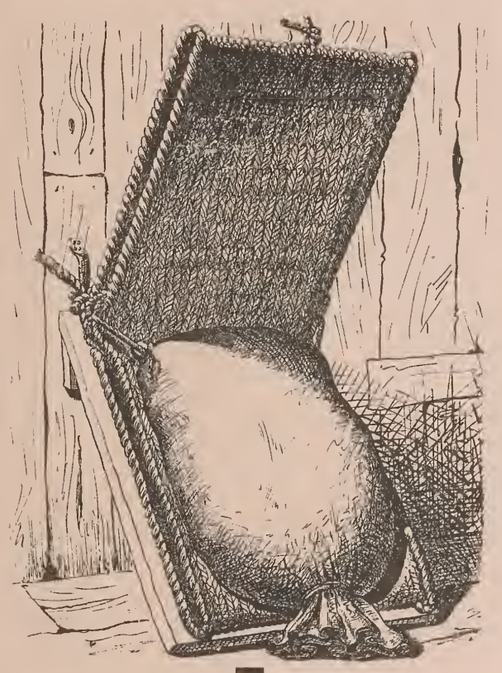
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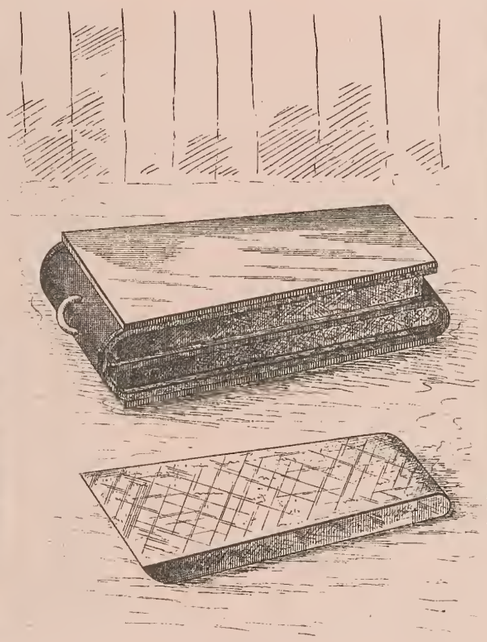
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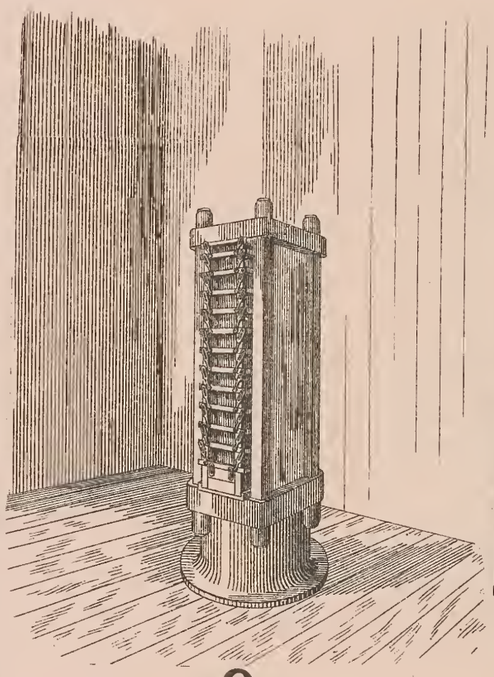
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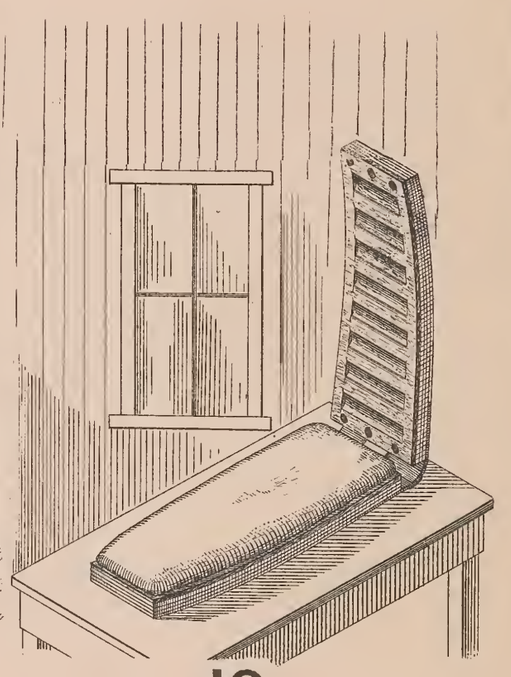
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OIL PRESSES AND MATS.

OIL PRESSES AND MATS.

No 1. U. S. Patent, Oil Press—A. D. 1822.
2. " " " " —A. D. 1857.
3. " " " " —A. D. 1862.
4. " " " " —A. D. 1863.
5. " " Cylinder Oil Press—A. D. 1867.
6. " " Oil Cake Envelope—A. D. 1870.
7. " " Mat or Squeezer—A. D. 1874.
8. " " Oil Press Envelope—A. D. 1882.
9. " " " " Box—A. D. 1882.
10. " " " " Mat—A. D. 1884.

The oil press was invented by Aristæus, the Athenian, 1450 B. C., in the time of Joshua.

The most ancient oil mills were those used in Palestine, at a very early date, for mashing the olive.

The oil presses used by the Phœnicians, in the time of Solomon, are the same as are used at the present day in Syria and Palestine.

King Solomon supplied Hiram with 20,000 baths of oil. The means used for expressing the oil was a mill and lever press.

Screw presses for oil and wine were known to the Romans of the Empire.

In China the pestle and mortar are used in reducing to powder the seeds of the oil-bearing tea plant. The meal is boiled in bags, and pressed to yield the oil.

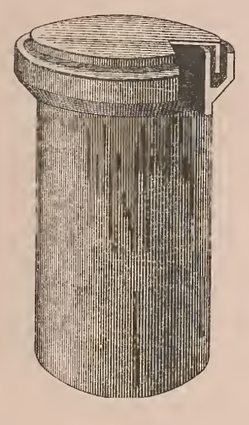
Charles Whiting, of Massachusetts, received U. S. Letters Patent March 2, 1799, for extracting oil from cotton seed.

The press for the expression of oil may be worked by screw, wedge, or hydrostatic power.

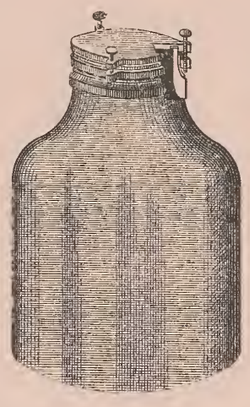
OIL PRESSES AND MATS.

166 Patents Granted by the United States.

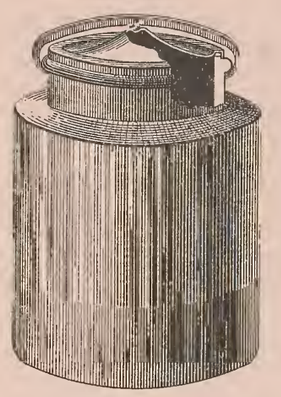
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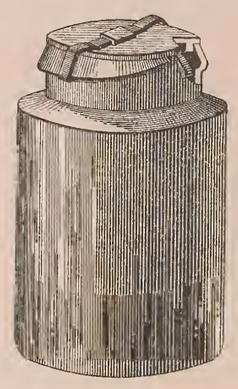
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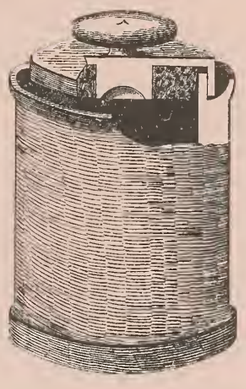
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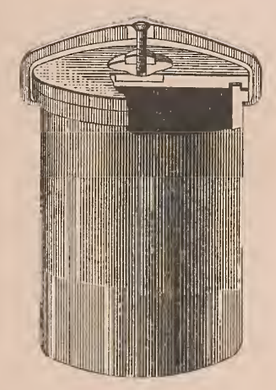
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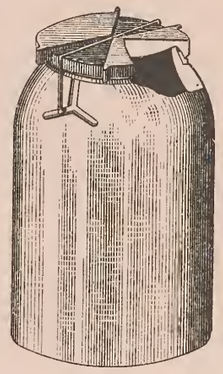
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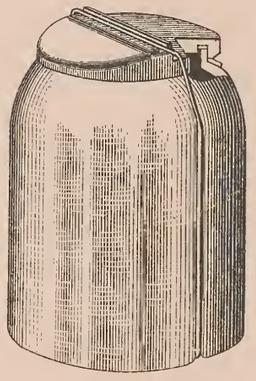
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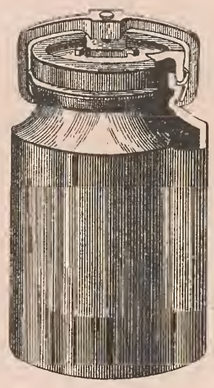
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FRUIT JARS.

FRUIT JARS.

No. 1. U. S. Patent, Self Sealing—A. D. 1855.
2. " " Hermetic Sealing—A. D. 1858.
3. " " Conical Cover—A. D. 1860.
4. " " Glass—A. D. 1865.
5. " " " —A. D. 1868.
6. " " Jar Cover—A. D. 1875.
7. " " Cover Fastener—A. D. 1878.
8. " " Jar Fastener—A. D. 1879.
9. " " Preserve Jar—A. D. 1881.
10. " " Jar Stopper—A. D. 1882.
11. " " Self Sealing—A. D. 1883.
12. " " Beveled Cover—A. D. 1883.
13. " " Jar Fastener—A. D. 1883.
14. " " Jar Cover—A. D. 1883.
15. " " Cover Fastener—A. D. 1884.
16. " " " " —A. D. 1884.

The analogue of our modern fruit jar is found in those of the ancient Egyptians, who seem to have been given to laying in great stores of provisions in this way. They had lids or stoppers, which were luted or rendered air tight by liquid clay, pitch, gypsum or mortar. Some had flat bottoms, and others being pointed were set in a stone ring.

Jars for preserving fruit are made of earthenware or glass. Glass jars were formerly blown like bottles, but are now usually pressed and blown in molds.

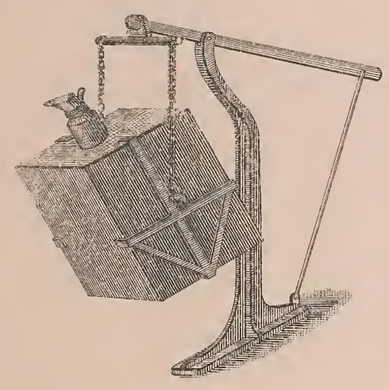
The exercise of ingenuity has principally been concerned with the modes of closing to render them air-tight, protecting the contents from access of oxygen and consequent fermentation. Among the devices for this purpose are lids which screw down on the threaded neck of the jar. Another form is a flat or flanged lid pressed down upon a gasket on the lip by some mechanical locking device.

There are ten factories engaged in the manufacture of glass fruit jars in Pittsburgh, Penn., U. S.

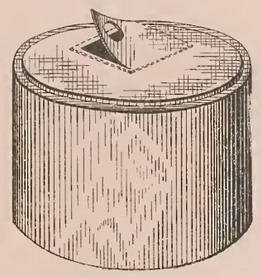
FRUIT JARS.

356 Patents Granted by the United States.

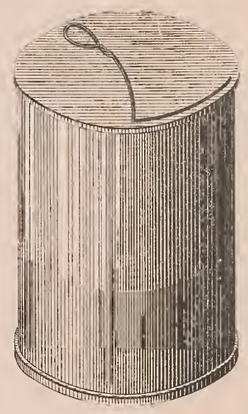
Sackett & Wilhelms Litho Co New York



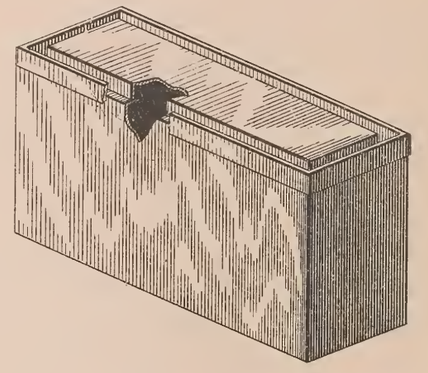
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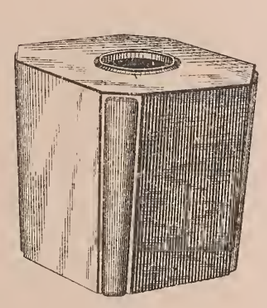
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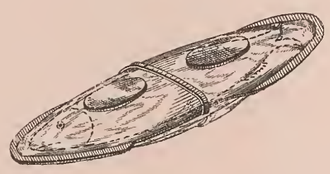
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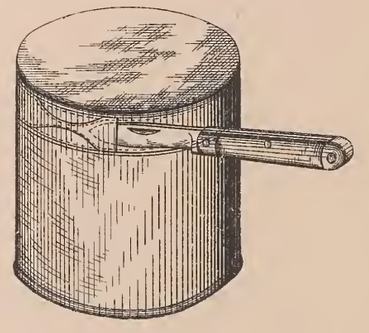
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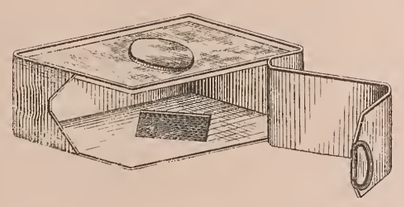
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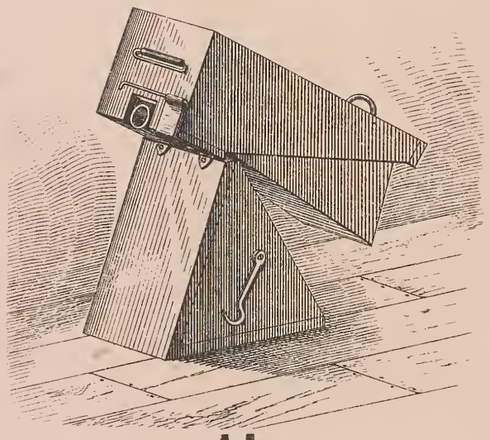
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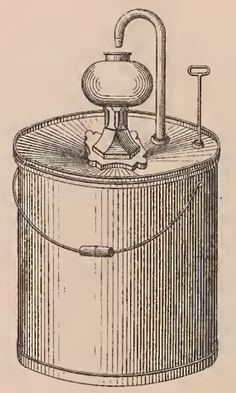
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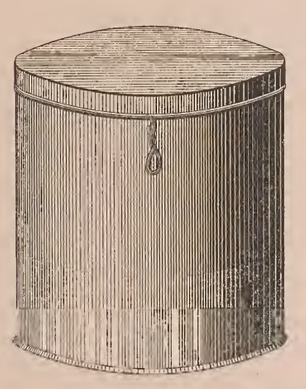
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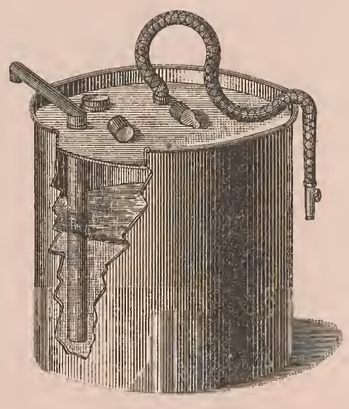
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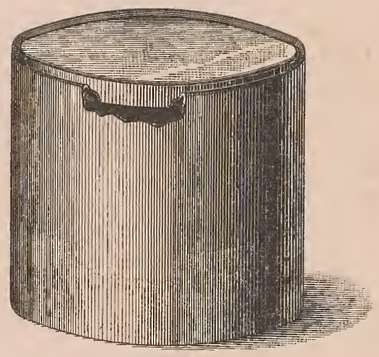
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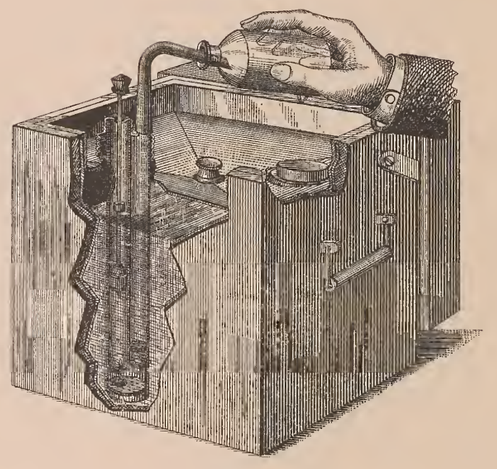
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16

METAL PACKING AND STORING CANS.

METAL PACKING AND STORING CANS.

No 1. U. S. Patent, Tilting Carboy—A. D. 1871.
2. " " Rip Patch Can—A. D. 1875.
3. " " " " —A. D. 1878.
4. " " Knock Down Cover Can—A. D. 1879.
5. " " Pyramidal Can—A. D. 1879.
6. " " Double Fish Can—A. D. 1879.
7. " " Fruit Can—A. D. 1879.
8. " " Rip Strip Can—A. D. 1879.
9. " " Rip Side Can—A. D. 1879.
10. " " Shipping and Filling Can—A. D. 1879.
11. " " Safety Shipping Can—A. D. 1881.
12. " " Lamp Filling Can—A. D. 1881.
13. " " Rip Wire Can—A. D. 1881.
14. " " Lamp Filling Can—A. D. 1883.
15. " " Knock Down Cover Can—A. D. 1884.
16. " " Transporting and Dispensing Can—A. D. 1884

Vases, made of umbricated or overlapping plates, supposed to be soldered together, are represented on the tombs of Thothmes, 1490 B. C.

The most popular packing and storing cans are the light tin receptacles now manufactured annually by millions. In these are packed fruits and vegetables of all sorts, oils, cocoa, meats, sardines, lobsters, crabs, and in fact everything that is produced on land or sea.

These cans are filled with the desired product, and then rendered air-tight by soldering on a tin top.

Metal packing and storing cans preserve their contents for years in a state of comparative freshness, and have proved a most useful invention.

One of the earliest objections to metal packing cans was the difficulty of opening; to obviate this, a tin pocket on the top was made thinner than the rest of the can, and this pocket ripped open by means of a small wire attached inside, which cut through the thin tin without difficulty.

Shears, or can openers, of peculiar shape, and made for the purpose of cutting through the tin, have also been invented.

When the pork industry became so prominent in the central part of this country, a large tin barrel, with a closely-fitting removable top, was patented, in which lard was packed. Smaller vessels were also used, in which lard was stored for transportation and for daily use.

When the various oils took the place of the tallow and wax candle, the combustible fluid was stored almost entirely in metallic vessels.

An adjustable oil can was constructed, from which the oil could be poured into a smaller can without coming in contact with the air.

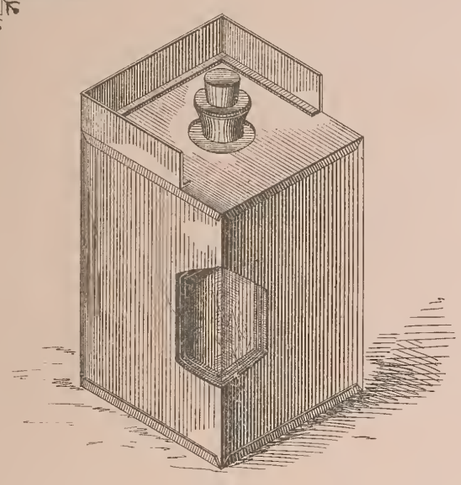
Large quantities of food, stored in metallic cans, are consumed in the United States and throughout the entire civilized world. The ships of the Navy and the merchant marine are stored with them.

Every year the demand increases, and every year invention adds some new device which is calculated to better preserve the contents of the cans.

METAL PACKING AND STORING CANS.

2,148 Patents Granted by the United States.

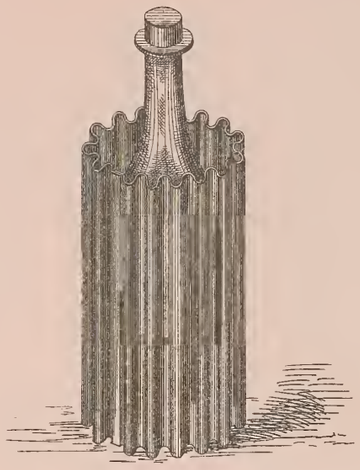
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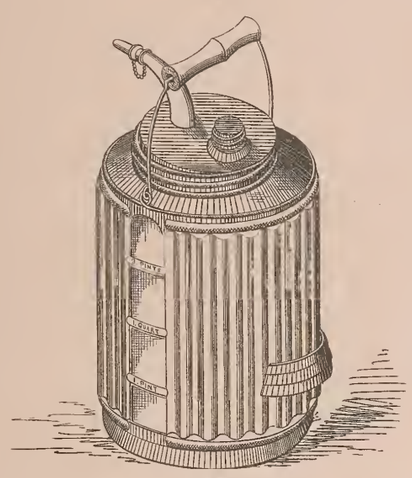
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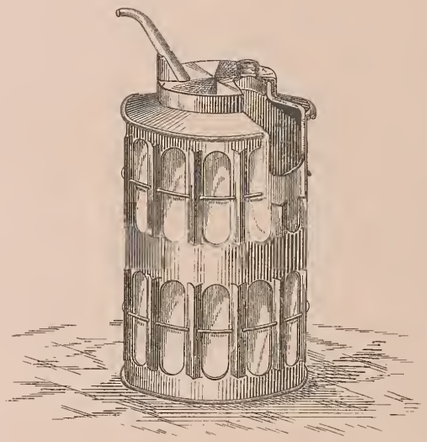
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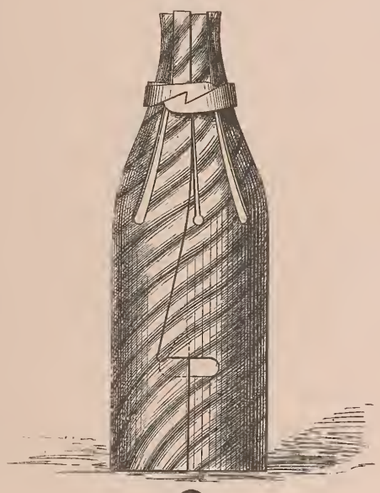
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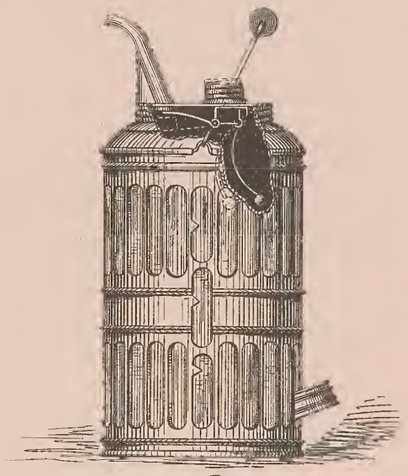
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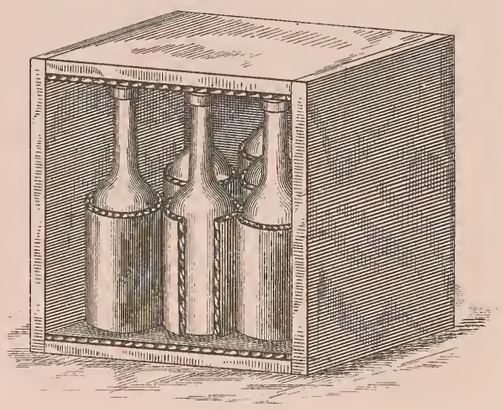
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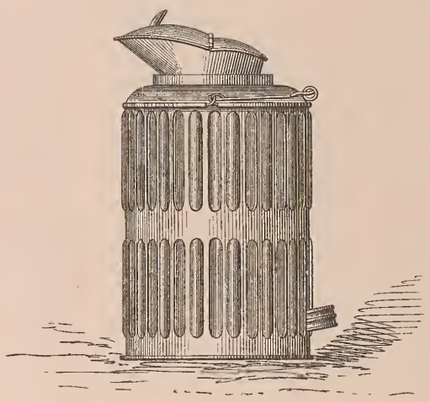
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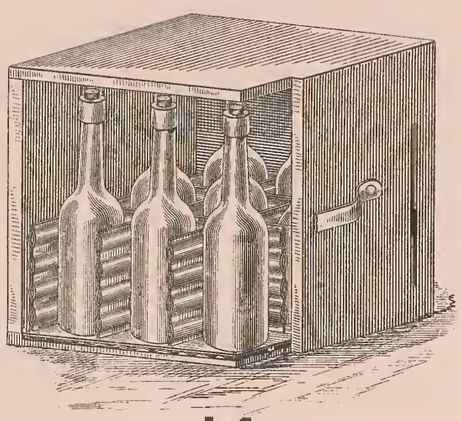
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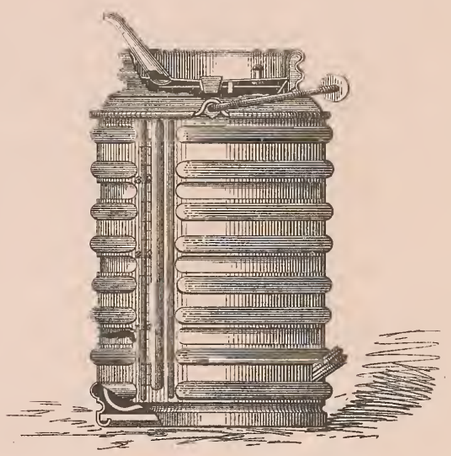
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JACKETED VESSELS AND WRAPPERS.

JACKETED VESSELS AND WRAPPERS.

No. 1. U. S. Patent, Encased Flask—A. D. 1863.
2. " " Bottle Wrapper—A. D. 1871.
3. " " Packing for Bottles—A. D. 1874.
4. " " Encased Glass Vessel—A. D. 1877.
5. " " " Oil Can—A. D. 1878.
6. " " Bottle Wrapper—A. D. 1880.
7. " " " " —A. D. 1880.
8. " " Jacket for Cans—A. D. 1881.
9. " " Bottle Wrapper—A. D. 1881.
10. " " Encased Glass Vessel—A. D. 1883.
11. " " Bottle Wrapper—A. D. 1883.
12. " " Encased Can—A. D. 1883.
13. " " Bottle Wrapper—A. D. 1884.
14. " " " Packing—A. D. 1884.
15. " " Encased Vessel—A. D. 1884.
16. " " Bottle Wrapper—A. D. 1884.

The word flask is derived from the Greek, Phlaskeion, which was a vessel woven of twigs.

The thin glass bottles, wrapped around with rushes or straw, were common in Germany at the commencement of the 16th century.

Modern wrappers consist of various devices and materials. Corrugated, fluted, crimped and perforated paper, pasteboard, paper tubes, wooden sheets, wood veneers, strips of wood coiled spirally, felt strips, straw sheaths, stalks of tall grass and vegetable fibers, are used in different forms for protecting and enveloping bottles.

JACKETED VESSELS AND WRAPPERS.

299 Patents Granted by the United States.

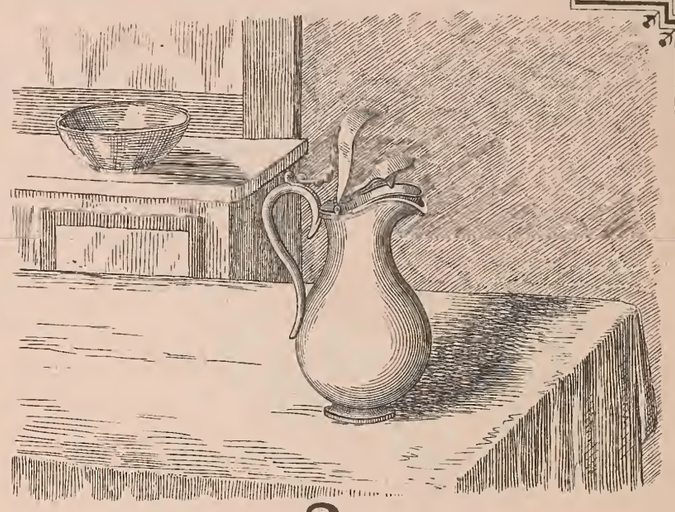
Sackett & Wilhelms Litho Co New York



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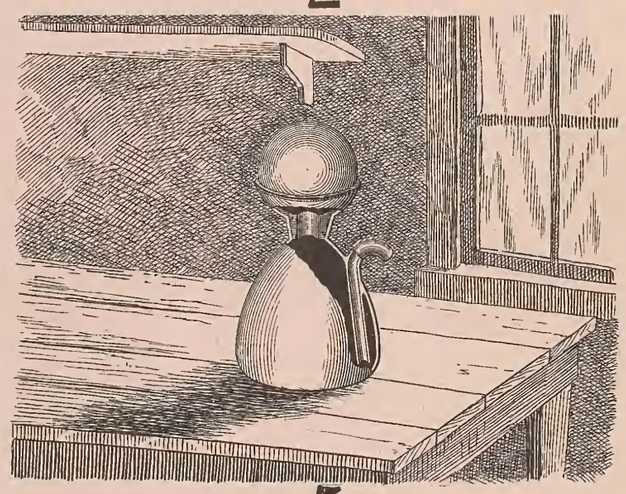
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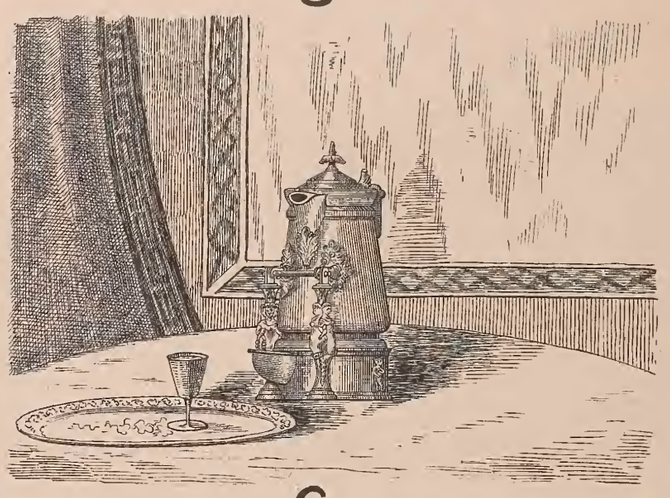
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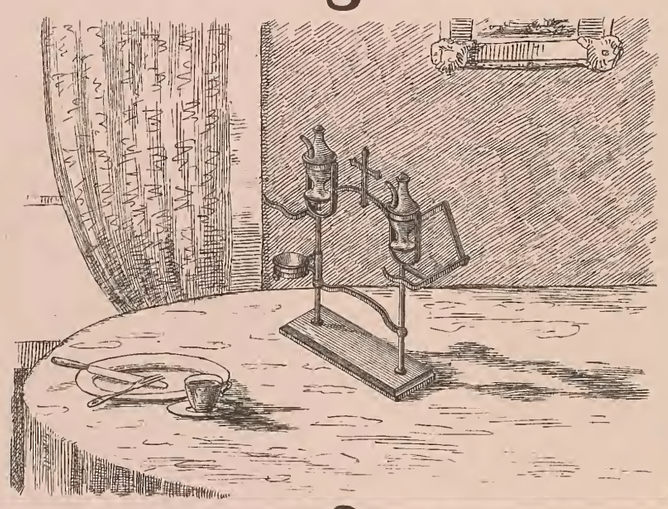
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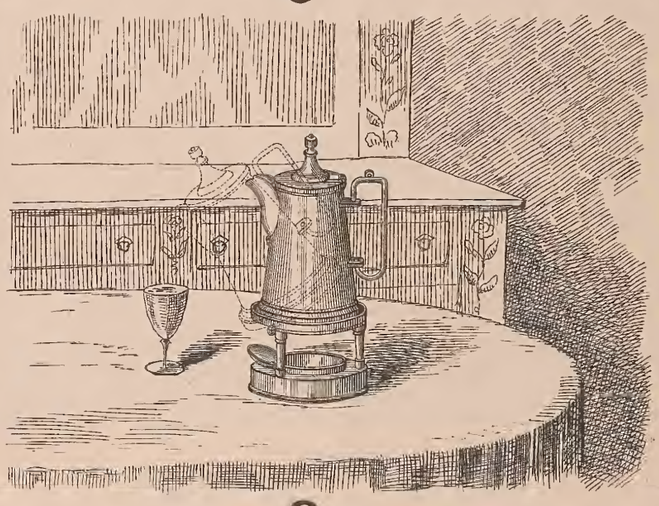
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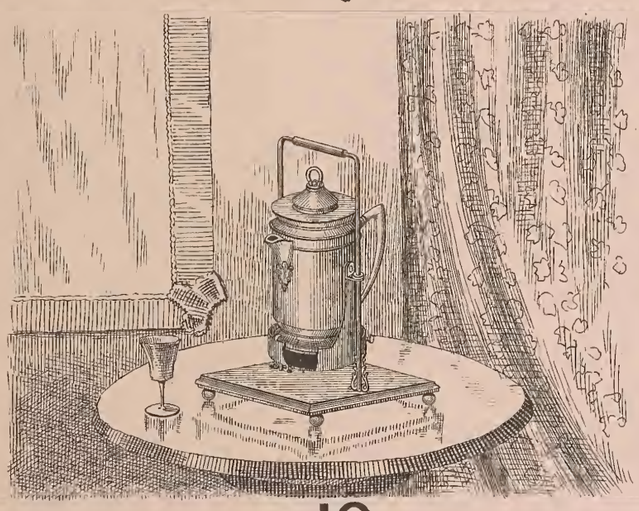
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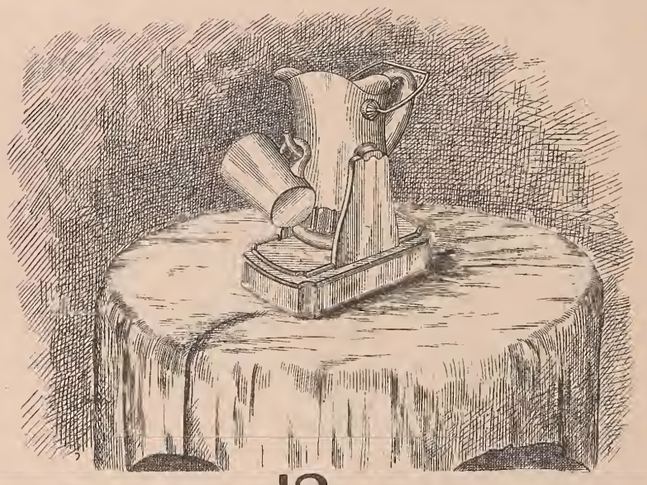
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12

PITCHERS, CRUETS AND STAND.

PITCHERS, CRUETS AND STANDS.

No. 1. U. S. Patent, Molasses Pitcher—A. D. 1855.
2. " " " " —A. D. 1857.
3 " " Pitcher Lid—A. D. 1860.
4. " " Pitcher—A. D. 1866.
5. " " Sirup Pitcher—A. D. 1869.
6. " " Ice " —A. D. 1871.
7. " " Molasses Jug—A. D. 1872.
8. " " Tilting Cruet—A. D. 1877.
9. " " Ice Pitcher Stand—A. D. 1879
10. " " Tilting Pitcher—A. D. 1881.
11. " " Detachable Pitcher Spout—A. D. 1882.
12. " " Tilting Vessel—A. D. 1884.

Pitchers are of great antiquity and are frequently referred to in the Bible.

In the last chapter of Ecclesiastes we read:

"Or ever the silver cord be loosed, or the golden bowl be broken, or the pitcher be broken at the fountain, or the wheel broken at the cistern."

These beautiful figures of speech indicate the remoteness of the history of the vessels therein referred to.

The modern tea pot, oil jars, the common pitcher, vases, &c., are all to be seen in Egyptian paintings.

The most primitive way of carrying water and wine was in carefully tanned skins. This was followed by a crude style of pottery, remains of which are to be found in almost every quarter of the globe.

The Romans used many styles of pitchers.

Modern invention has produced most beautiful shapes and designs. These are made of china, porcelain, alabaster, silver, and the most costly of gold.

Pitchers are of every conceivable shape and variety, and yet each different design is readily recognized.

Molasses pitchers are of glass or china, with a silver lid. A wine pitcher is of cut glass with a stopper something like that of a decanter.

A most useful invention is the silver ice pitcher. These show great varieties. The first patent was a plain pitcher with a closely-fitting lid. Later inventors devised the tilting ice pitcher, with a spout something like an ordinary spigot. This patent has been very generally utilized. Silver stands for coffee, tea, &c., are now made with this spout, so as to tilt at the slightest motion of the hand.

The revolving cruet is common to every household. The glass bottles that fit into the silver holes are for the various condiments used for seasoning food. This is an ancient vessel. The epicures of Rome used them made of precious metals.

Modern casters are of many different shapes and sizes; the commonest has a silver case, into which fits six bottles; a smaller caster has only two or three bottles. A useful and portable caster is made of twisted silver wire, with only three small bottles.

Pickle stands, celery stands and other similar appliances of the table may be properly mentioned under this head.

TABLE ARTICLES.

PITCHERS, CRUETS AND STANDS.

271 Patents Granted by the United States.

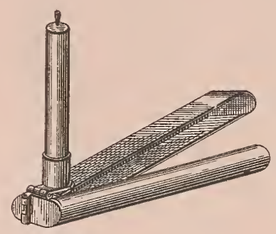
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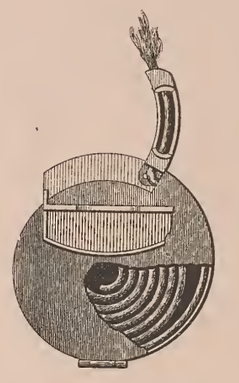
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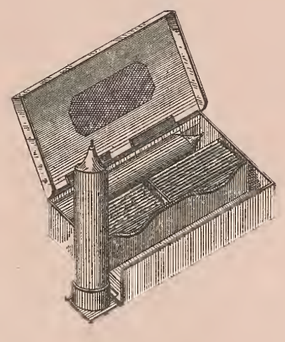
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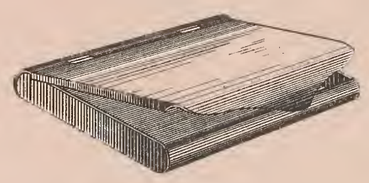
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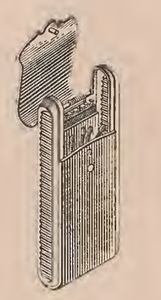
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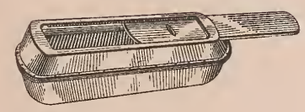
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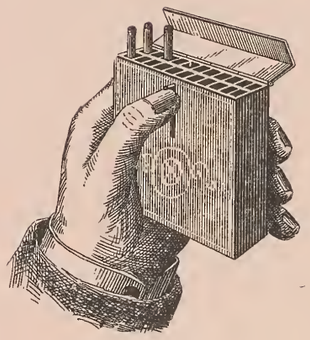
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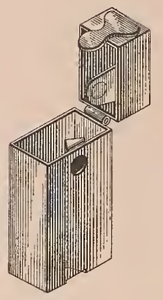
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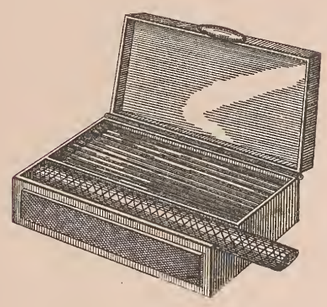
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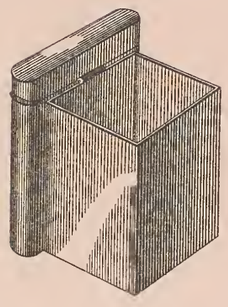
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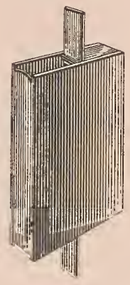
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METAL POCKET BOXES.

METAL POCKET BOXES.

No. 1. U. S. Patent, Tobacco Box—A. D. 1860.
2. " " Match Safe—A. D. 1861.
3. " " Match Box and Taper Holder—A. D. 1867.
4. " " Pocket Safe—A. D. 1868.
5. " " Match Box—A. D. 1869.
6. " " Portable Lighter—A. D. 1875.
7. " " Tobacco Box—A. D. 1876.
8. " " Match Safe and Pin Cushion—A. D. 1876.
9. " " Tobacco Box—A. D. 1879.
10. " " Match Safe—A. D. 1880.
11. " " " Box—A. D. 1880.
12. " " " " and Cigar Cutter—A. D. 1881.
13. " " Portable Lighter—A. D. 1882.
14. " " Match Box Flame Guard—A. D. 1882.
15. " " " and Tooth Pick Box—A. D. 1883.
16. " " " Box—A. D. 1883.

The most ancient predecessor of the modern metal box is the alabaster box of the ancients, which was used as a receptacle for whatever was desired to be preserved. Though alabaster is a white, granular variety of gypsum, it served the purpose of the modern metal box of the present day in a large measure.

We read of the alabaster box of precious ointment belonging to Mary of Capernaum. These boxes were durable and beautiful.

Jewelled boxes of frankincense, myrrh, and jewels, were rare gifts in ancient times.

We also read of a golden box containing only a withered rose, which was kept always on the dressing table of Anne of Austria. This withered rose was a souvenir of the gay and gallant Duke of Buckingham.

The boxes mentioned belong, however, to a past age, and are recalled only to show that even a box can, after research, call up interesting remembrances.

The 19th century deals almost exclusively with what is practical, and the golden and silver snuff boxes which were so fashionable a century ago are kept now only as pieces of interesting bric-a-brac.

The most useful of the metal pocket boxes of the day are, first, an oblong box in which chewing tobacco is kept. A companion to this is a match box.

Another useful box is a small, thin receptacle, which fastens with a spring and is divided into two compartments. Into one of these about one dozen stamps just fit, and into the other a half-dozen street car tickets can be kept.

The metal match box is an especial convenience. It protects other articles from contact with the match, and is a safeguard against ignition.

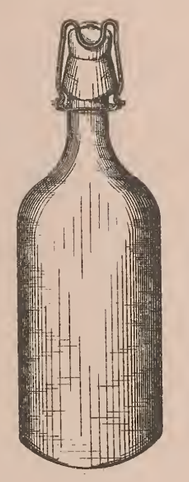
A great variety of boxes have been made since the old brimstone match was invented. One of the earliest and most popular was a round, wooden box, with a firmly-fitting top. The pasteboard match box succeeded this, to which a piece of sand-paper is attached for the sake of convenience.

Some pocket match boxes have a corrugated bottom or side, on which the match can be made to ignite with a slight stroke.

METAL POCKET BOXES.

43 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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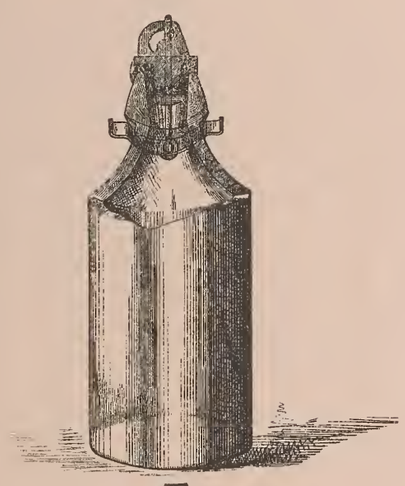
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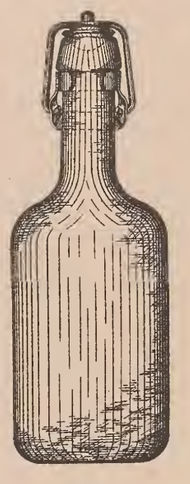
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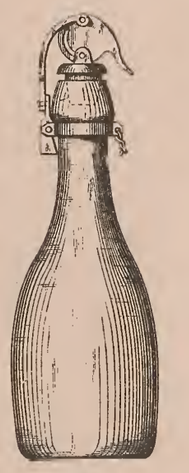
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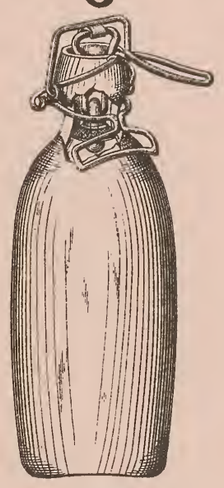
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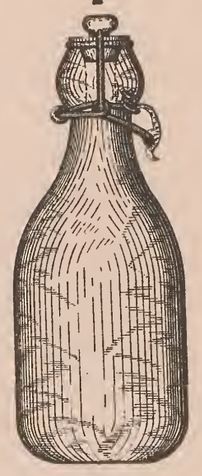
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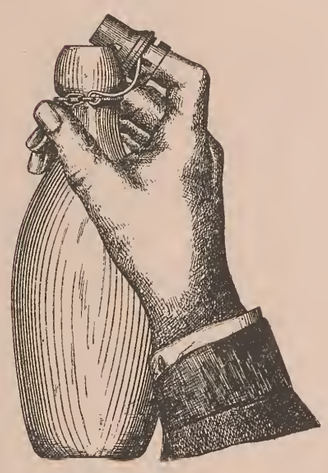
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BOTTLE STOPPERS AND FASTENERS.

BOTTLE STOPPERS AND FASTENERS.

No. 1. U. S. Patent, Wire Fastening—A. D. 1859.
2. " " Bottle Stopper—A. D. 1862.
3. " " " " —A. D. 1864.
4. " " Metal Cap Fastening—A. D. 1866.
5. " " Stopper Fastener—A. D. 1871.
6. " " Internal Stopper—A. D. 1874.
7. " " Stopper Fastener—A. D. 1876.
8. " " " " —A. D. 1878.
9. " " " " —A. D. 1879.
10. " " Internal Stopper—A. D. 1881.
11. " " Stopper Fastener—A. D. 1882.
12. " " " " —A. D. 1882.
13. " " " " —A. D. 1883.
14. " " " " —A. D. 1883.
15. " " " " —A. D. 1883.
16. " " Internal Stopper—A. D. 1884.

The ancient Greeks and Romans knew nothing of cork stoppers, and stopped with a tin mouth piece the earthen, or the then rare and dear glass vessels, which they took with them on journeys, wound with willow branches, bark, straw or rushes. The manufacture of these flasks was an important work in Athens, and from them descended the demijohn of to-day.

For a long time bottles were stopped with a flax stopper steeped in oil.

The invention of cork stoppers is attributed to the Benedictine monk, Perignon, who from 1668 to 1715 was butler at the farm of Hautvilliers. It is singular that glass bottles, which were extensively introduced in the fifteenth century, had no cork stoppers until near the end of the seventeenth century, when the first came into use in the apothecaries'' shops in Germany, and the stoppers of wax, which were more troublesome and expensive, were laid aside.

Modern bottle stoppers and fasteners consist of many devices, known as valve, screw, internal and expanding stoppers, and cap and die, and swing stopper fasteners.

The bottling of liquids has attained great proportions as a distinct business, and the appliances for fastening the corks have been well studied and brought to a considerable degree of perfection.

BOTTLE STOPPERS AND FASTENERS.

715 Patents Granted by the United States.

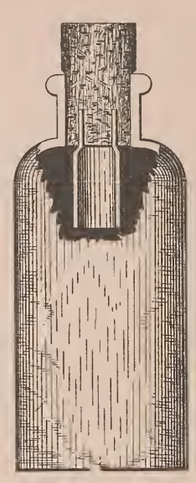
Sackett & Wilhelms Litho Co New York



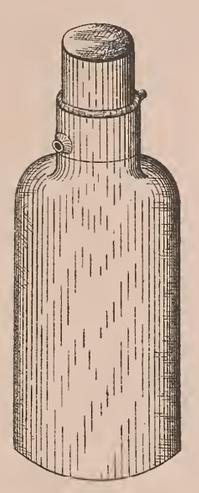
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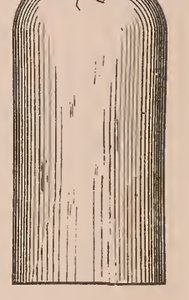
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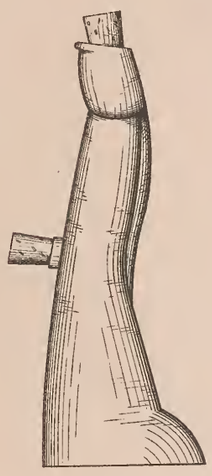
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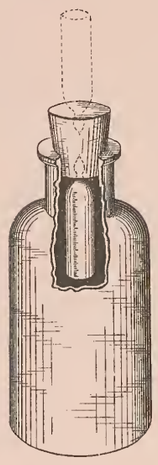
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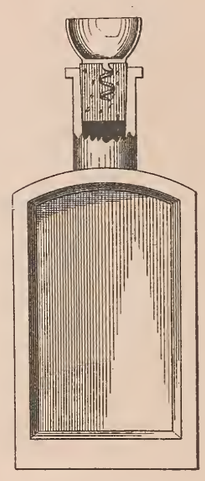
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DOSING AND DROPPING BOTTLES.

DOSING AND DROPPING BOTTLES.

No. 1. U. S. Patent, Measuring Nozzle—A. D. 1864.
2. " " Medicine Gauge—A. D. 1866.
3. " " Medicine Bottle—A. D. 1868.
4. " " Dropping Vial—A. D. 1868.
5. " " Medicine Dropper—A. D. 1868.
6. " " Dropping Bottle—A. D. 1875.
7. " " Stopper and Dropper—A. D. 1876.
8 " " Stopper and Measure—A. D. 1879.
9. " " Dose Measure—A. D. 1881.
10. " " Dropping Bottle—A. D. 1881.
11. " " Graduated Stopper—A. D. 1881.
12. " " Dose Cup and Stopper—A. D. 1882.

In the Book of Jeremiah occurs the passage "Thus saith the Lord: Go, and get a potter's earthen bottle."

Metal, earthen and glass bottles were used by the Egyptians, Assyrians, Greeks and Etruscans. The Jews probably obtained their knowledge of them from the Egyptians.

Glass bottles made several centuries B. C. were found at Babylon.

Glass bottles were known to the Romans of the Empire, and specimens have been found at Pompeii.

Glass is the material almost universally employed in the manufacture of bottles; it is generally of the coarsest kind, made from inferior materials.

Bottles were formerly made by blowing and rolling, but since the introduction of presses blowing and molding have been combined.

Beer and wine bottles are blown in molds.

The manufacture of glass bottles, on account of the nature of the material, is very simple, although for the production of fine work great skill is required.

The various bottles used for different well-known purposes are generally distinguished by peculiar shapes and sizes, as the English wine, beer, ale and soda bottles; the French Champagne, Burgundy and Claret, and the Rhenish wine bottles.

Port wine is occasionally put into very large bottles called "magnums," and acids into still larger, termed "carboys."

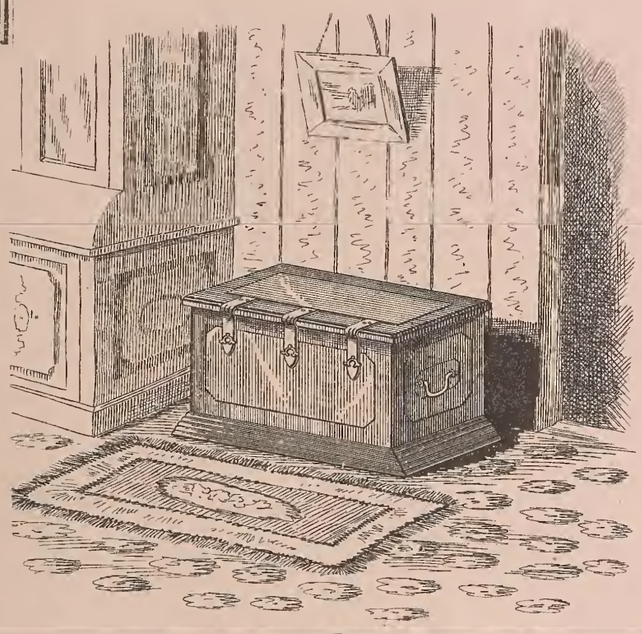
Demijohns are large bottles covered with wicker work.

Medicine bottles are of a great variety of sizes and shapes.

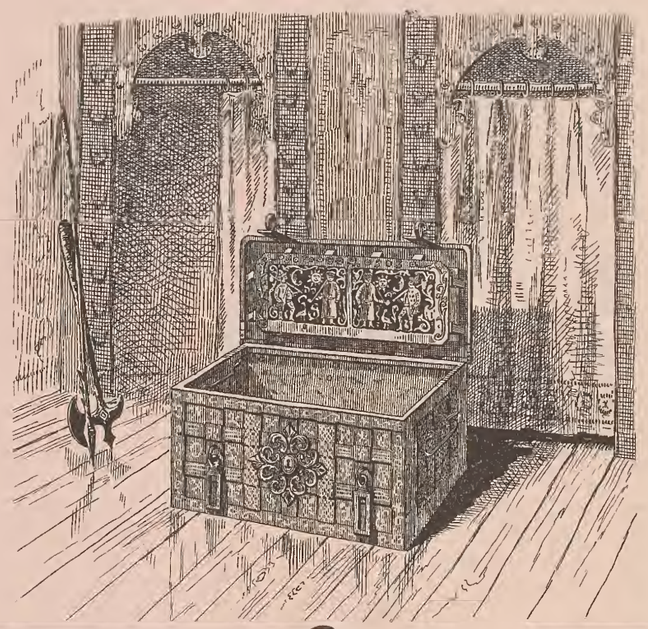
DOSING AND DROPPING BOTTLES.

28 Patents Granted by the United States.

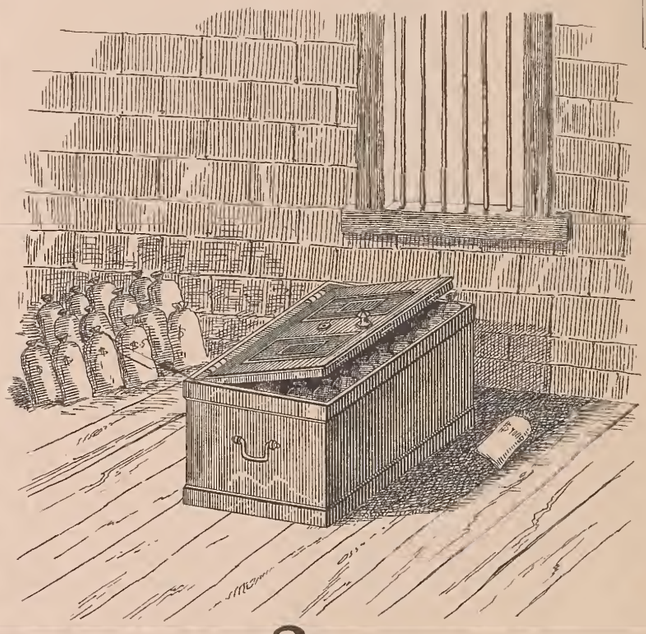
Sackett & Wilhelms Litho Co New York



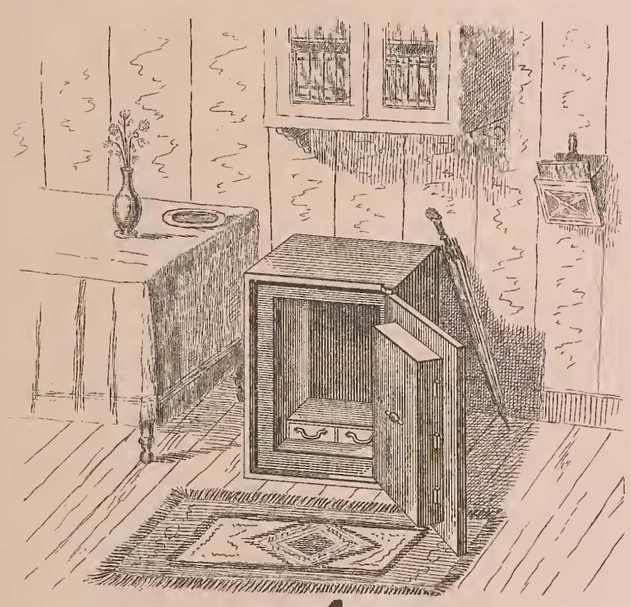
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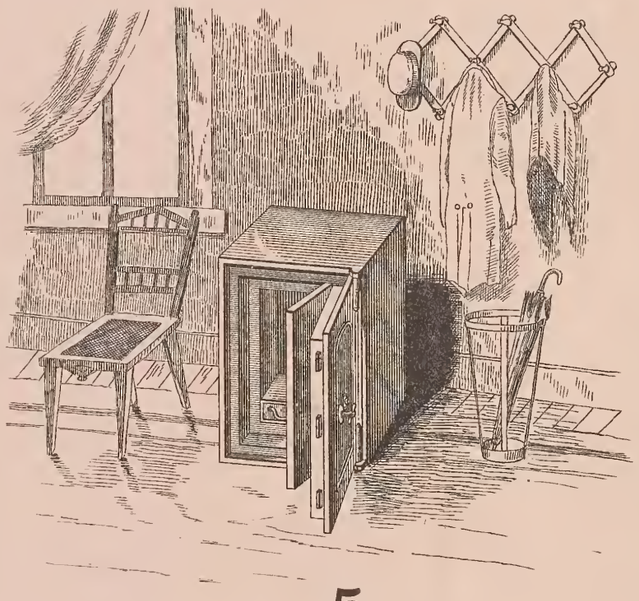
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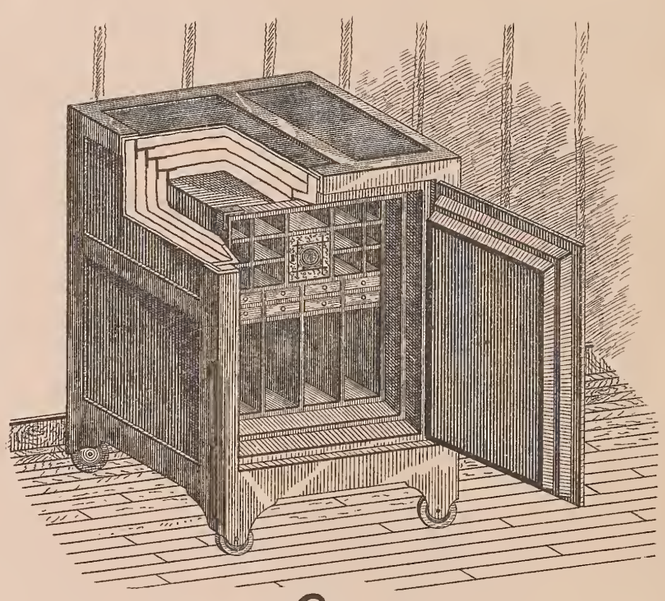
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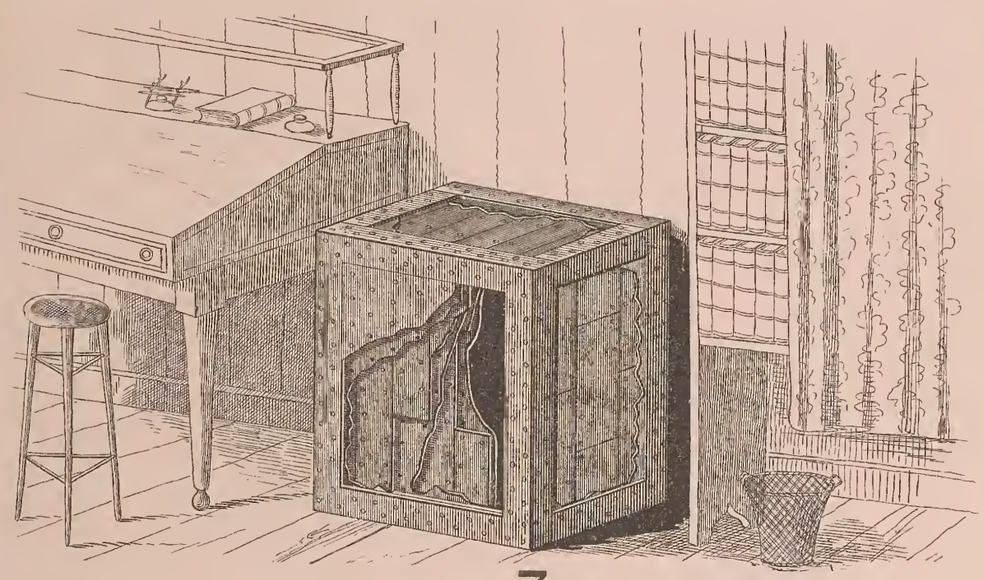
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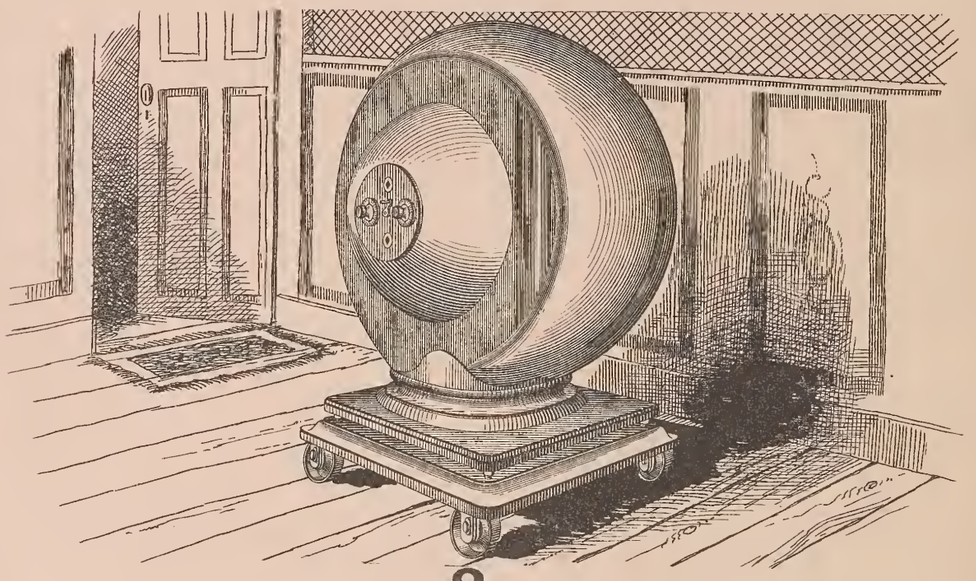
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SAFES.

SAFES.

No. 1. Primitive Oak Chest.
2. " Iron Bound Coffer.
3. " Money Chest.
4. Single Door Boiler Plate.
5. Fire Proof Door.
6. " " "
7. Square Laminated Safe.
8. Spherical Safe.

Until the present century the usual safes were boxes of oak or other hard wood, more or less strengthened by iron bands, and provided with several locks.

The Crown Jewels of Scotland were, in 1707, deposited in an oaken chest.

The first patent for fire resisting safes was granted Richard Scott, of England, in 1801.

The so-called fire proof safes were made in Paris, France, in 1820, by introducing a layer of plaster of Paris between the inner and outer surfaces of the box.

The first American safes that obtained any celebrity were those constructed under the patent of Gayler, in 1833.

Asbestus was first used as a packing for safes in 1834.

Chubb patented, in 1835, a process of rendering wooden safes burglar proof by lining them with steel or case hardened iron plates.

The great fire in New York, of 1835, gave rise to many new inventions for increasing the fire proof quality of safes. That of B. G. Wilder obtained precedence, and safes of this plan are still in use; they were constructed of heavy plates of iron, with a filling of hydrated gypsum, hydraulic cement, alum and the neutralized and dried residuum of the so-called soda water manufacture.

Mention is made of a safe within a safe, (constructed in 1850,) with filling of fire brick, melted alum and clay.

Among the strongest safes are those patented in 1851 by Lewis Lillie, of Troy, New York.

Gulick, in 1857, made a water proof marine safe, having compartments filled with air or cork.

Rhodes, in 1859, admitted a flow of cold water to circulate between the inner and outer walls of a safe and its door, by a valve which opened when the temperature reached 212 degrees.

The first electric magnetic alarm attachment for safes was by Vasley, in 1865.

The Herring safes display excellent workmanship and finish. They are constructed of heavy iron, specially prepared from the Franklinite iron of New Jersey, on account of its superior hardness.

Safes of the largest size, as now constructed, are spacious closets, filled with shelves, drawers and compartments, with time locks and other appurtenances.

SAFES.

40 Manufactories in the United States.

	1880	1880
Capital Invested,	$1,026,800.00	$2,201,600.00
Value of Productions,	1,910,079.00	3,352,396.00
Wages Paid,	471,924.00	1,096,504.00
Hands Employed,	1,093	2,206

304 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



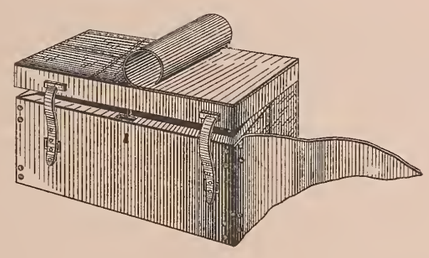
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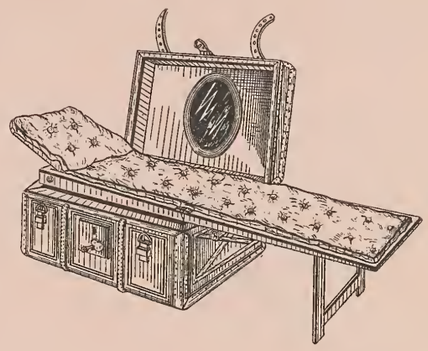
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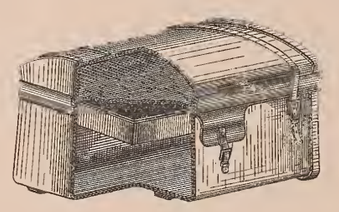
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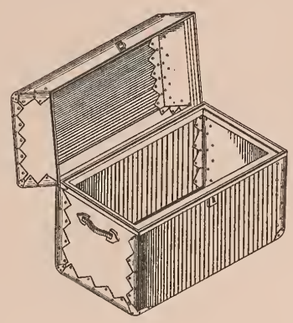
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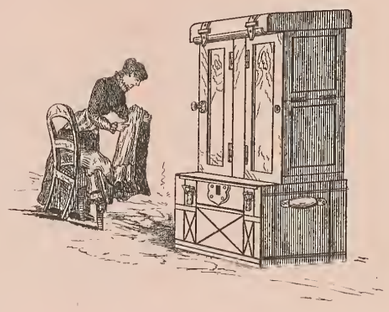
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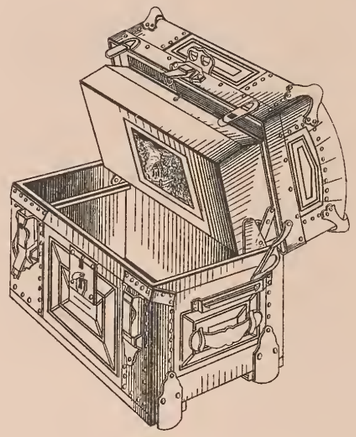
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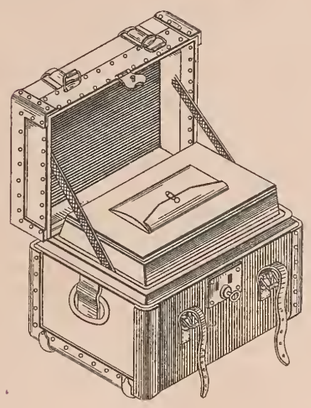
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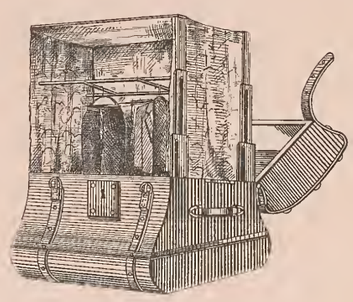
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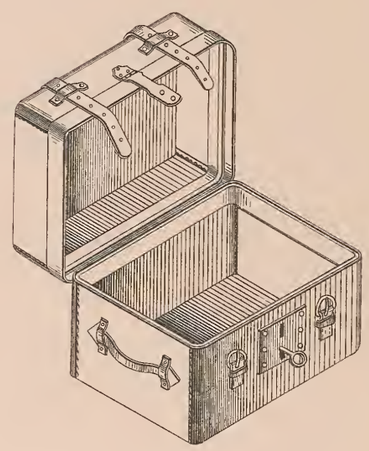
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TRUNKS.

TRUNKS.

No 1. Primitive.
2. Japanese, 15th Century.
3. Gripsack.
4. U. S. Patent, Leather—A. D. 1836.
5. " " Bed—A. D. 1861.
6. " " Veneer—A. D. 1865.
7. " " Sheet Steel—A. D. 1871.
8. " " Bureau—A. D. 1871.
9. " " Saratoga—A. D. 1872.
10. " " Sole Leather—A. D. 1873.
11. " " Wardrobe—A. D. 1873.
12. " " Vulcanized Fiber—A. D. 1876.

Satchels are of very ancient use. The name is from the Greek "Sakkos," and means a bag or sack.

Shakespeare writes of both a satchel and trunk.

A gripsack is something similar, and derives its name from the fact that it is generally carried in the hand.

Trunks were primarily rude wooden boxes for clothes or toilet articles. A covering of skin was added as their use became more general and travel more extended.

A very substantial trunk of the last century was made of horse skin tanned with the hair on. This was fastened on the box, with a flat or rounded top, with bright brass tacks, which were considered highly ornamental. These horse hair trunks were succeeded by leather trunks strapped with steel or wooden strips.

A cheap and portable trunk is a wooden box with curved lid covered with cloth and sometimes with paper in imitation of leather.

As early as 1596 the trunk-makers of France were incorporated into a company.

Roulston's trunk is one noted for its strength and durability. It has angle pieces to strengthen the corners, and guards to project from the corners of the body when shut. The corner longitudinal strips are bent at right angles at their ends to lap over vertical and transverse corner strips. The lower corner guards have projections for attachment and protection of the casters. The hinges are bent to lap around the ends of the trunk. A spring catch holds the lid case into the lid.

A Saratoga trunk was so named from the vast size it attained on account of the amount of clothing considered necessary for the person who frequented that favorite and fashionable resort, Saratoga Springs. This trunk attained huge proportions, and later inventions show it in the form of a folded wardrobe and bureau. Its compartments are many and various, and it is capable of holding without injury a great number of dresses and other articles of the toilet.

Trunks are made of wood, leather, paper, cloth, a preparation of zinc and other materials.

The best trunk for ordinary land travel is one made of thick sole leather strapped with bands of the same material. No wood is used in the manufacture of this trunk, and it is capable of withstanding the roughest usage the average railway porter can administer. The best trunk for ocean travel is known as the steamer trunk, and is always bought by naval officers. This is perfectly flat on top, and is made of heavy sole leather, strapped with the same. It is made so as to fit squarely into its place and not roll about with other baggage.

Satchels and gripsacks are made of the same variety of material. Alligator skins are also coming into use for the manufacture of these useful articles.

TRUNKS.

265 Establishments in the United States.

	1860	1880
Capital Invested,	$935,800.00	$2,792,256.00
Value of Productions,	2,836,969.00	7,252,470.00
Wages Paid,	692,572.00	1,786,586.00
Hands Employed,	2,092	4,534

628 Patents Granted by the United States.

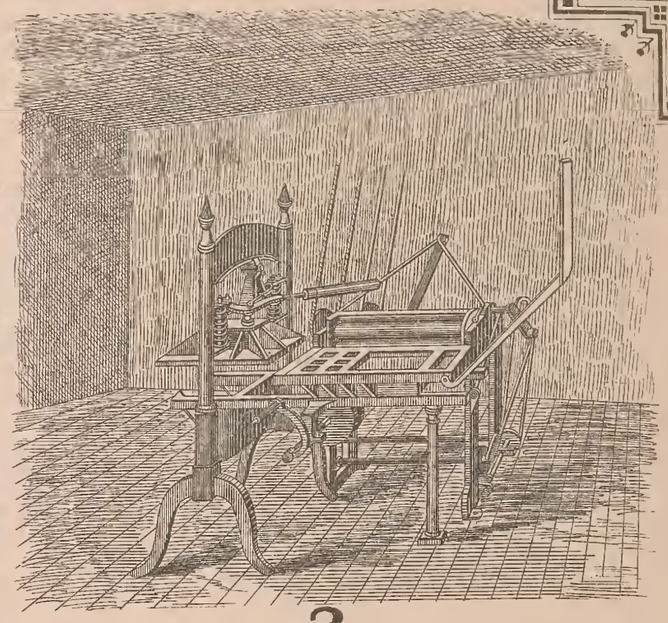
Sackett & Wilhelms Litho Co New York



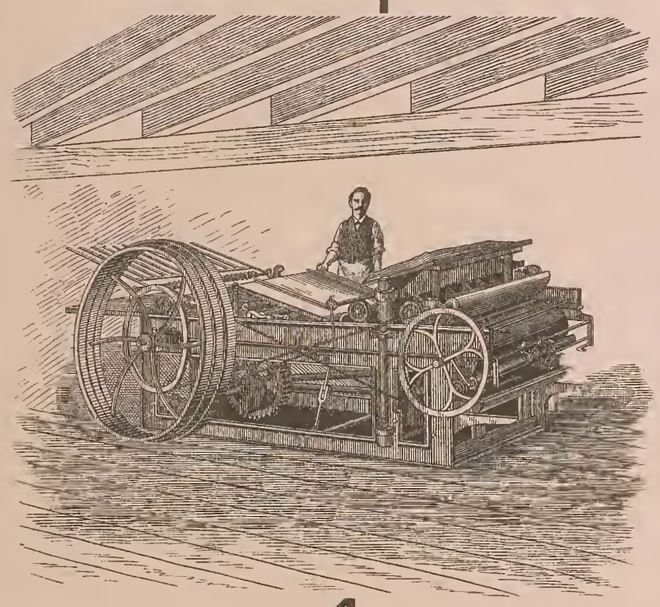
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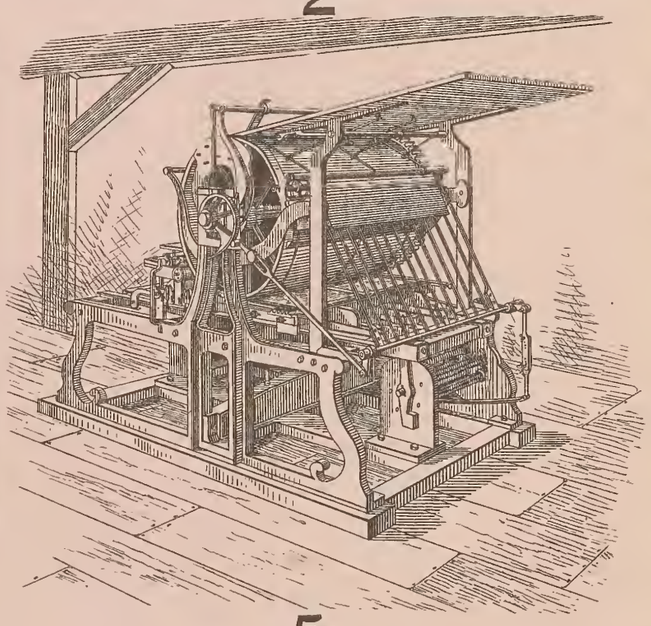
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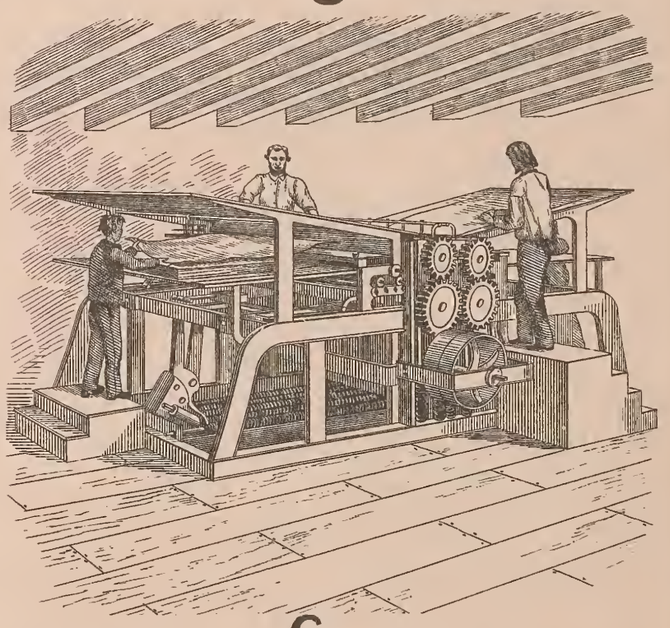
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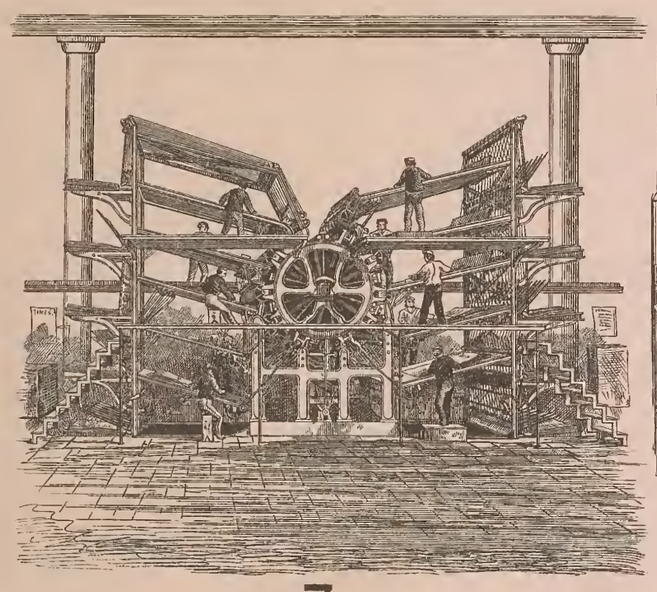
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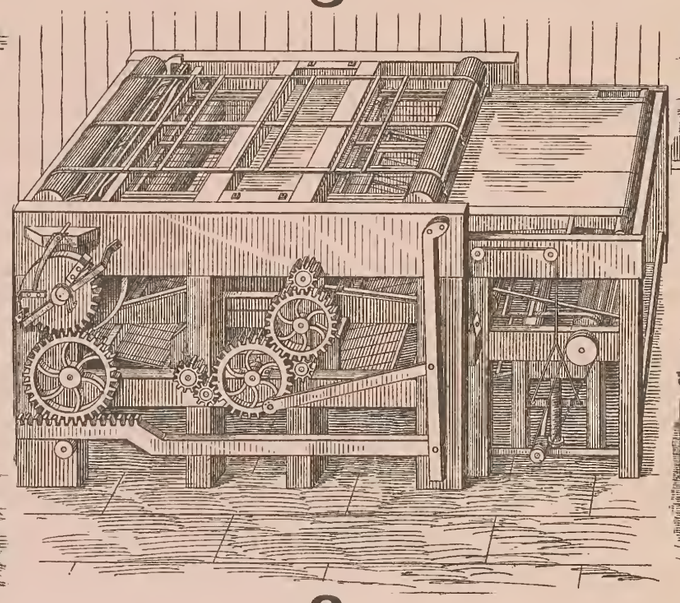
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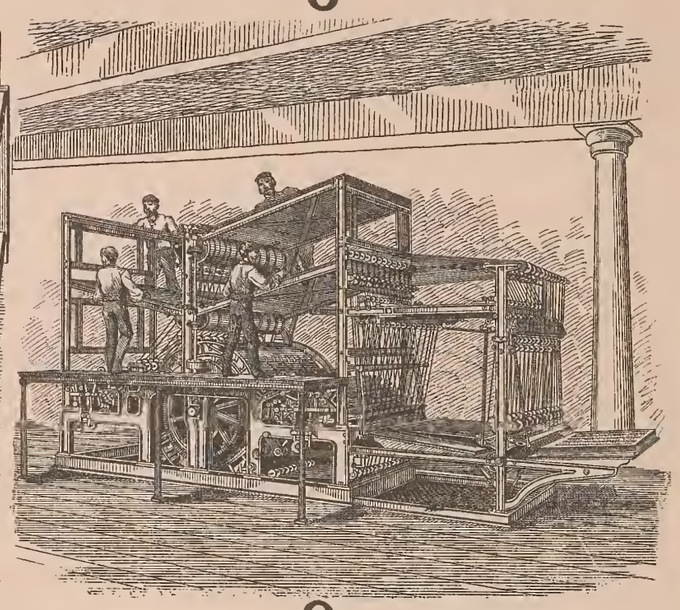
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9

PRINTING MACHINES--SHEET.

SHEET PRESSES.

No. 1. Primitive Press—A. D. 1548.
2. Franklin's Hand Press—A. D. 1725.
3. U. S. Patent, Flat Bed and Platen Hand Press—A. D. 1829.
4. " " Flat Bed and Platen Power Press—A. D. 1830.
5. " " Impression Cylinder, Flat Form—A. D. 1845.
6. " " Two-Impression Cylinder, Flat Form—A. D. 1845.
7. " " One Type Cylinder, Ten Impressions—A. D. 1847.
8. " " Two Flat Forms and Platen—A. D. 1858.
9. " " Rotary Perfecting, 4 and 8 Feeders—A. D. 1872.

The art of Printing was known forty centuries ago.

Ancient Assyrian and Egyptian seals exist whose surfaces were blacked and then pressed upon bark, a leaf or skin, thus delivering an impression, either with white marks on black ground or black on white ground, according to the character of the engraving. The kings of Egypt stamped their names upon their grants and orders. Tablets of clay were impressed by engraved cylinders, then baked. Some of the ancient stamps in the British Museum are of bronze, and have raised letters.

The first printed pages are found in the Chinese annals, 1120 B. C. DuHale supposed it to have been invented 930 B. C.

The Venetians introduced block printing.

The earliest impressions were taken by a mallet and smooth faced block of hard wood.

The oldest newspaper in the world is the King Pau, or Capital sheet, published in Pekin. It first appeared A. D. 911, but was issued irregularly until 1351. Since that date it was published weekly until June 4, 1832, when, by order of the reigning Emperor, it was converted into a daily, with three editions—morning, midday and evening. The issue is called Heing Pau (business sheet) and contains trade prices, exchange quotations and all manner of commercial intelligence. The daily edition varies from 13,000 to 14,000.

In the fifteenth century the art of printing by movable type was invented in Germany, and introduced into France, Italy and England.

Bleauw, of Amsterdam, made improvements on the printing press in 1620.

The first printing press in the New World was used in Mexico, in the sixteenth century, by Spanish missionaries. A mutilated copy of a book printed at that time by Juan Cromberger, is preserved in the library at Madrid, Spain. This press was used in Mexico in less than a century after the art became known in Europe, and nearly a century before its introduction into the United States.

The first press established in the United States was at Cambridge, Mass., in 1639. Rev. Jesse Glover was the first person who undertook the task of establishing a printing press in the United States. He raised the money for its purchase, went to England, bought it and had it shipped to Boston, Mass. He died on the return voyage to America. The Glover press was put in working order by S. Daye, who published the "Freeman's Oath," the first newspaper ever published in the American Colonies. He was succeeded by Samuel Green, who obtained a grant of 300 acres of land from the crown in encouragement for his zeal.

The first Indian printer known was employed in Massachusetts in the year 1639. An Indian boy was apprenticed to Green to learn the trade. He became an expert printer, and a worthy member of society, and took the name of James Printer. He rendered valuable aid in printing the Indian Bible. John Eliott said, "Printer was the only man who was able to compose the sheets and correct the press." The "Psalter," printed in 1709, bears the imprint: "By James Printer, for the Co., for the Propagation of the Gospel, &c."

The first family newspaper established in North America was in 1704.

The first negro who appeared in an American printing office was employed by Thomas Fleet, in Boston, Mass., in the year 1709.

The English and Indian languages were printed on the University Press, at Harvard, in 1709. About this time a printing press was established in New London, Conn.

James Franklin, a brother of Benjamin Franklin, established a periodical in Boston in 1721.

The first printing press south of Philadelphia, was set up at Annapolis, Md., in 1726.

Benjamin Franklin used the Bleauw press in London.

Nicholson patented a power press in 1790.

The first press west of the Alleghany Mountains was located in Cincinnati, in 1793, and the first west of the Mississippi River, in St. Louis, in 1808.

In 1814, a German constructed a printing machine for the "London Times," this being the first newspaper printed by machinery driven by steam power.

In 1815, Cowper obtained a patent for curved electrotype plates to be affixed to a cylinder.

Clymer, of Philadelphia, invented the Cumberland hand press in 1817.

The first power printing press in the United States was invented by Daniel Treadwell, of Boston, in 1822.

The first lithographic establishment in the United States was established in Boston, Mass., in 1827.

The first important improvement of the Bleauw press was made by Earl Stanhope, in 1814, who invented a press made entirely of iron.

The Adams power press was invented in 1830, by Samuel Adams, of Boston, Mass.

Richard M. Hoe, of New York, first brought into practical use the rotary press, in 1847, and it was soon adopted by nearly all the daily papers in this country, and also in England, Scotland and Australia.

The perfected presses in use for printing the large newspapers, automatically feed, print, separate, fold and deliver many thousands an hour.

PRINTING MACHINES---SHEET.

11,314 Newspapers and Periodicals Published in the United States.

Published Daily,	971
" Weekly,	8,633
" Semi-weekly,	133
" Tri-weekly,	73
All others,	1,504

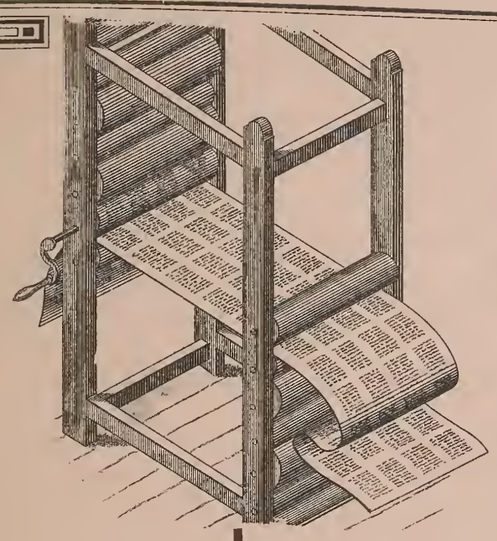
SUB CLASS.

SHEET PRESSES.

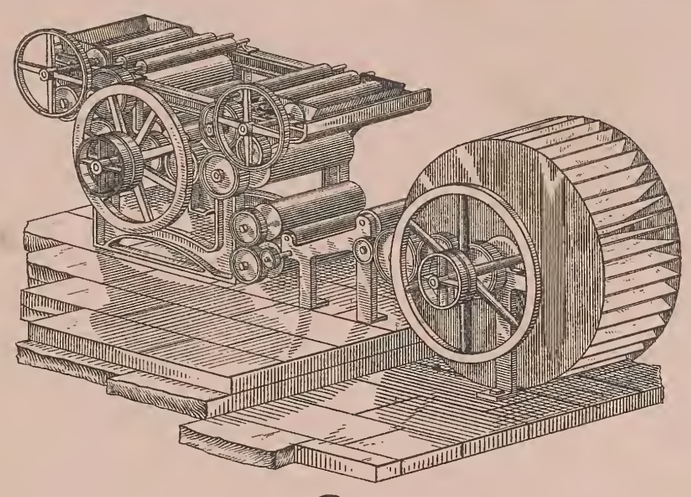
Capacity—	Primitive Mode.	Present Machine.
Sheets Printed per hour,	100	10,000
Hands Employed per hour,	2	2

3,268 Patents Granted by the United States.

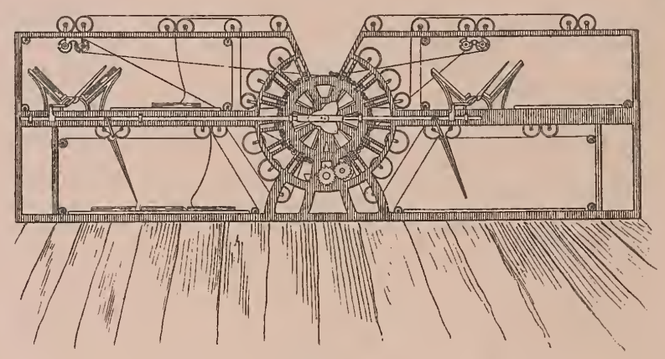
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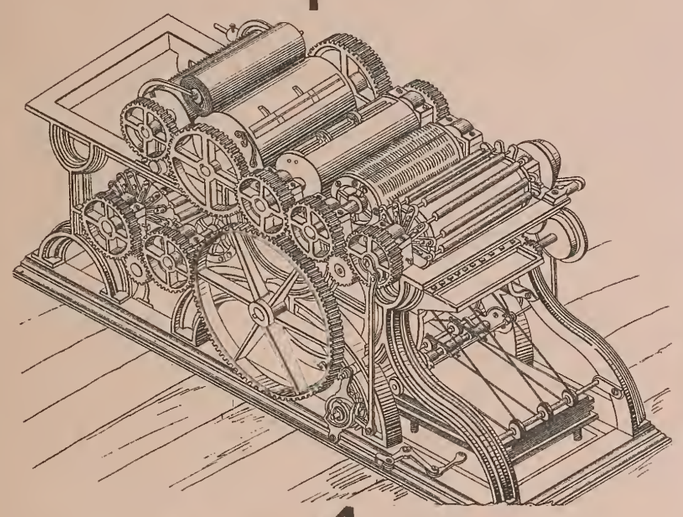
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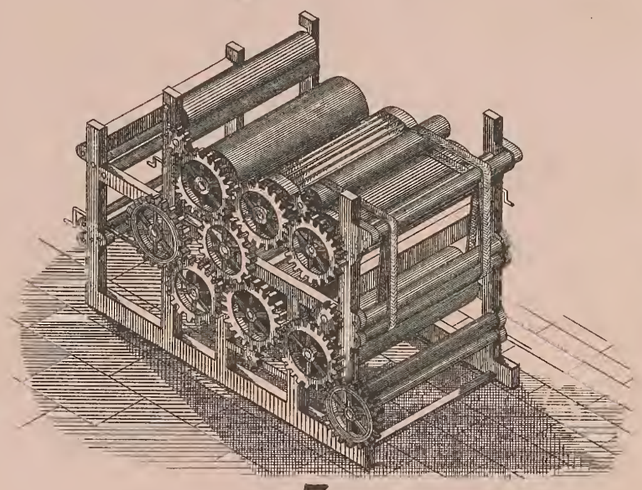
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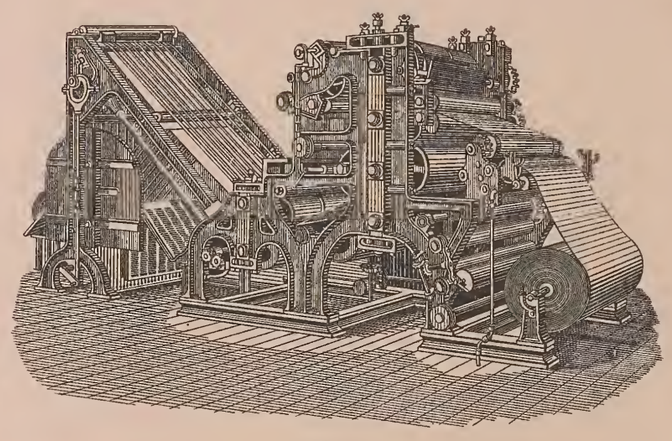
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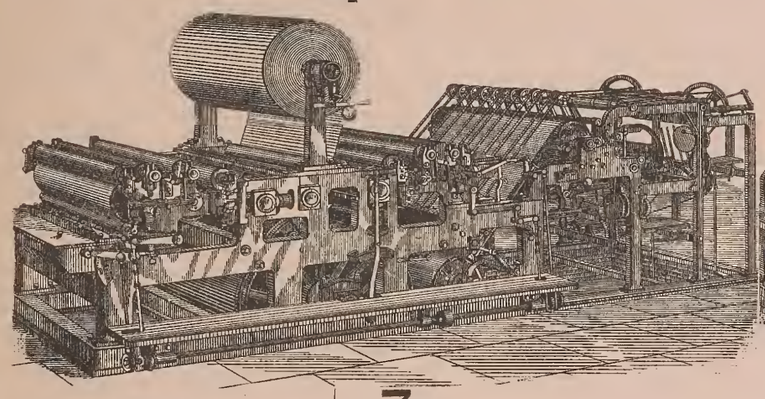
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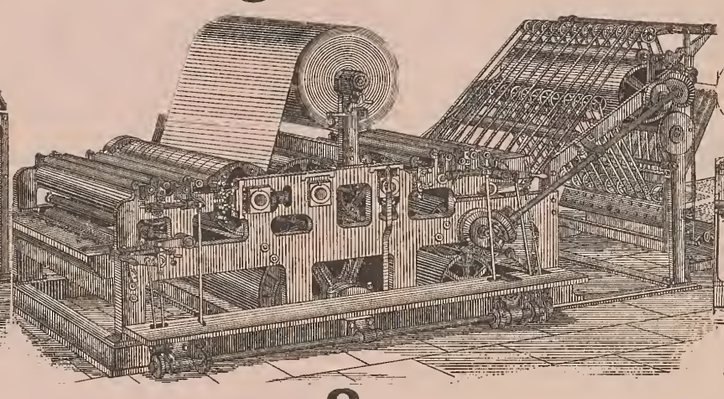
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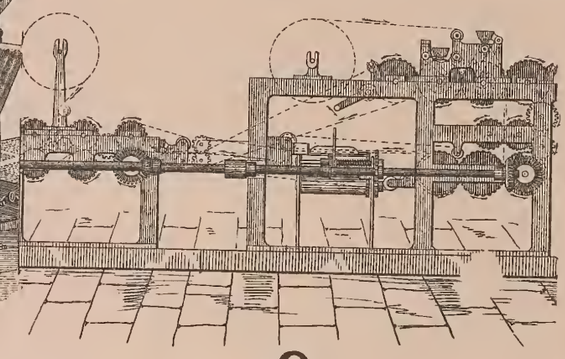
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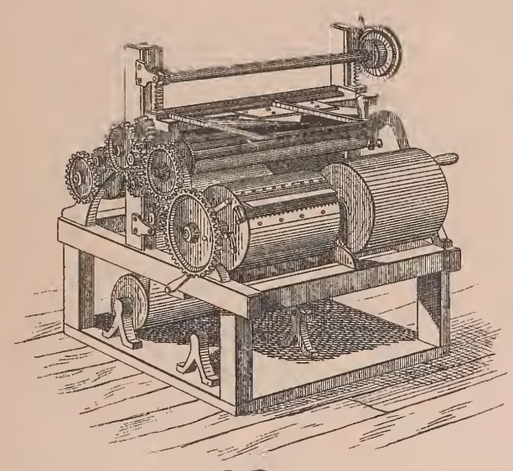
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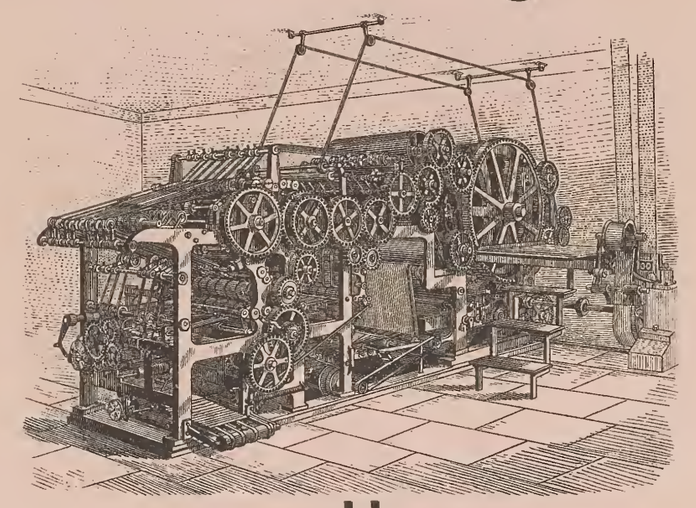
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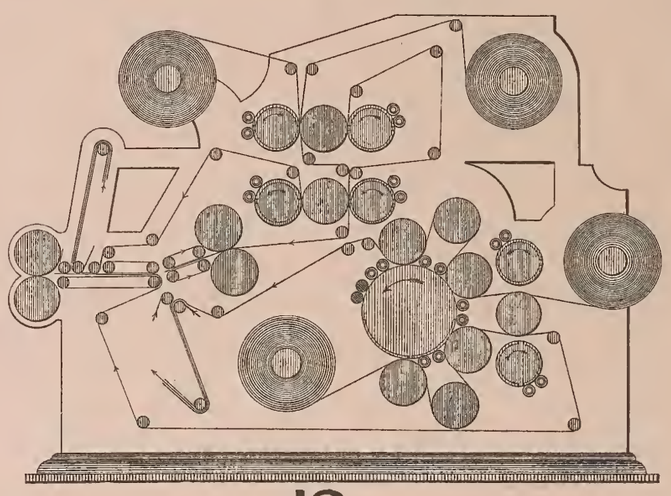
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PRINTING MACHINES--WEB.

PRINTING MACHINES---WEB.

No. 1. U. S. Patent, Prints a web from plates—A. D. 1822.
2. " " Prints a web from plates, perforates and tears off—A. D. 1851.
3. " " Prints two webs from types, cuts, and flies in four piles—A. D. 1853.
4. " " Cuts one web into sheets, prints from plates, and counts—A. D. 1863.
5. " " Prints two webs from type, and cuts into sheets—A. D. 1865.
6. " " Damps and prints one web from plates, cuts, and flies in two piles—A. D. 1866.
7. " " Prints one web from plates, perforates, tears and collects before flying—A. D. 1876.
8. " " Prints one web from plates, cuts and folds—A. D. 1876.
9. " " Prints from plates, two webs, cuts and folds together—A. D. 1877.
10. " " Prints from plates, two webs, cuts and folds, inserting supplement—A. D. 1879.
11. " " Prints from types one side of a web, turns over, prints other side, cuts and folds—A. D. 1880.
12. " " Prints from plates and types, one or four webs, collects sheets into one newspaper—A. D. 1882.

The history nf the Printing Press is the history of a wonder.

The pressing needs of the age require that the most perfect machinery should at all times be secured. It mav be interesting to review the one matter of press machinery, in order to see what a radical change has been made in the past quarter of a century in that department.

Passing by the old Franklin press, which was so called because used by Franklin, (it being the old Ramage press, with a capacity of two hundred and fifty impressions per hour, with the aid of two men,) we come in the earlier decades to the Washington press, worked, like the Franklin, by hand, giving from two hundred and fifty to three hundred impressions an hour, with two men, one to work the press and one to roll the type applying the ink.

In 1815, the London "Times" procured a König press, with a nominal capacity of eleven hundred impressions per hour, afterwards increased to eighteen hundred. This press was in use until 1827, when it was superseded by Applegate & Cowper's, with a rate of five thousand impressions an hour. This continued until 1848, when Applegate's improvements increased the rate to eight thousand impressions. In this year the Hoe cylinder press came into existence; the first made was for the New York "Sun," and had a rate of six thousand impressions an hour. Its fame was so great that one was ordered for the London "Times," and, with some improvements, it was claimed to have a rate of from eight to twelve thousand impressions an hour.

January 1st, 1849, witnessed the introduction of Hoe's lightning press. One was ordered for the Philadelphia "Ledger" and Baltimore "Herald," but the highest speed of this press was only ten thousand impressions an hour. Various improvements were made, so that it could run at the rate of fifteen thousand impressions an hour, and for twenty years this was the highest speed attained.

By increasing the number of cylinders, the capacity was increased, until in a ten cylinder press, with ten men to feed, a rate of twenty-five thousand impressions per hour could be reached.

In 1868 the Walter press was imported from England, where it had superseded the Hoe for printing the London "Times." Up to this date the impressions had been made on one side of the paper only. In the Walter press the paper dropped out printed on both sides. This press claimed a capacity, in 1875, of eleven thousand papers, or twenty-two thousand impressions an hour. The same year the Bullock press came into the field, with a capacity equal to the Walter. For many years the Hoe press had rested on its laurels, but Mr. Hoe soon introduced his perfecting press.

It gave twelve thousand papers an hour, and as late as 1877 this was the highest speed reached by any press.

In 1877, the Bullock struck off, with ease, twenty thousand complete newspapers an hour from one press.

In 1879, a Scott press was constructed in Chicago, and was found to have a capacity fifty per cent greater than either the Bullock, Walter or Hoe. It began rapidly to supersede all others. Its capacity was sixty thousand impressions in an hour, or thirty thousand newspapers, printed, cut and folded. In 1881 it had received various improvements, so that it reached the actual figures of thirty-two thousand papers, ready for the carrier, within sixty minutes.

PRINTING MACHINES---WEB.

11,314 Newspapers and Periodicals Published in the United States.

Published Daily,	971
" Weekly,	8,633
" Semi-weekly,	133
" Tri-weekly,	73
All others,	1,504

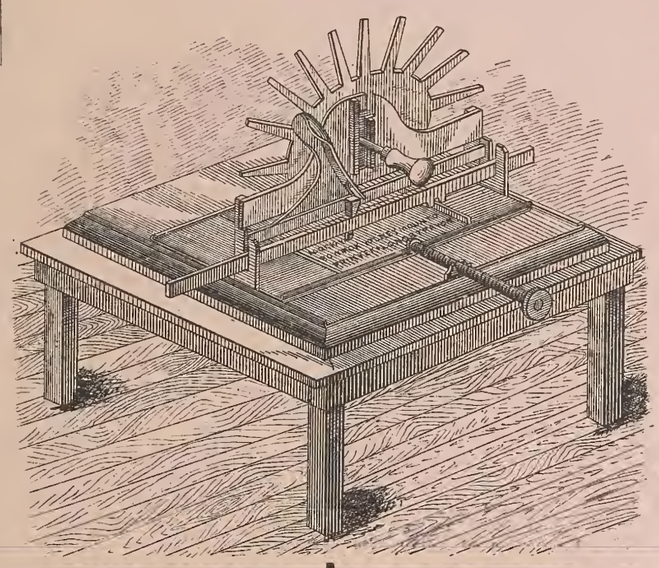
SUB CLASS.

WEB PRESSES.

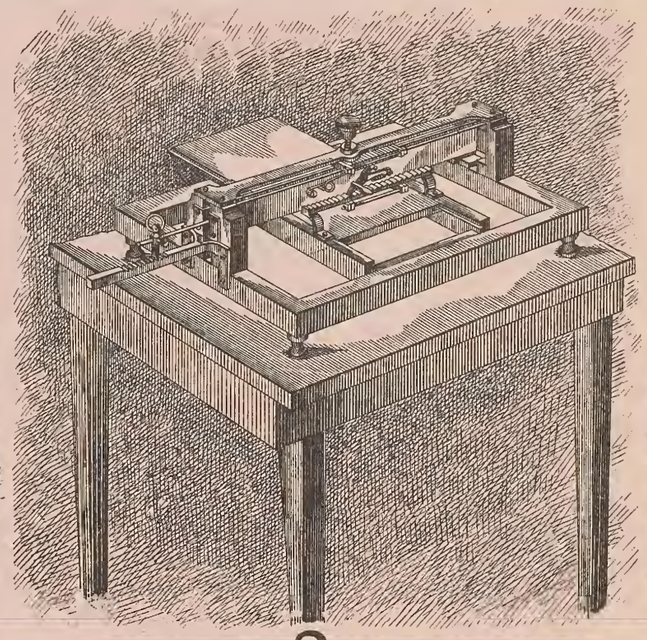
Capacity—	Primitive Made.	Present Machines.
Sheets Printed per hour,	100	50,000
Hands Employed per hour,	2	2

3,268 Patents Granted by the United States.

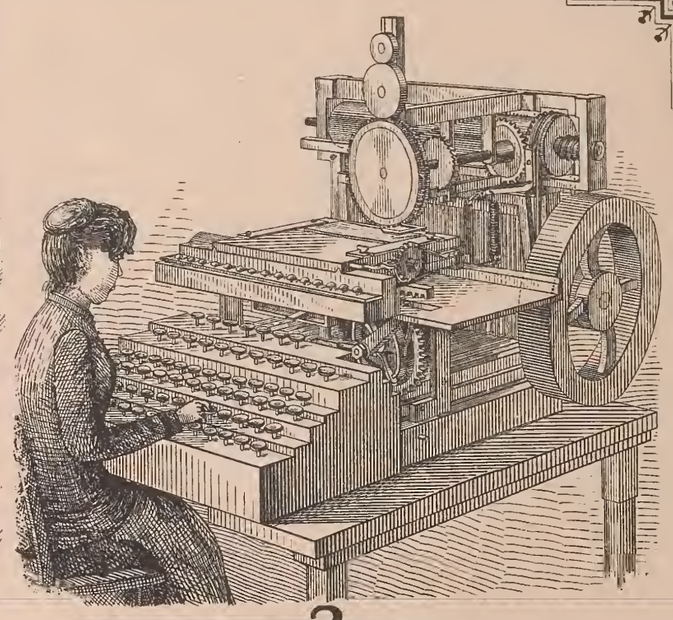
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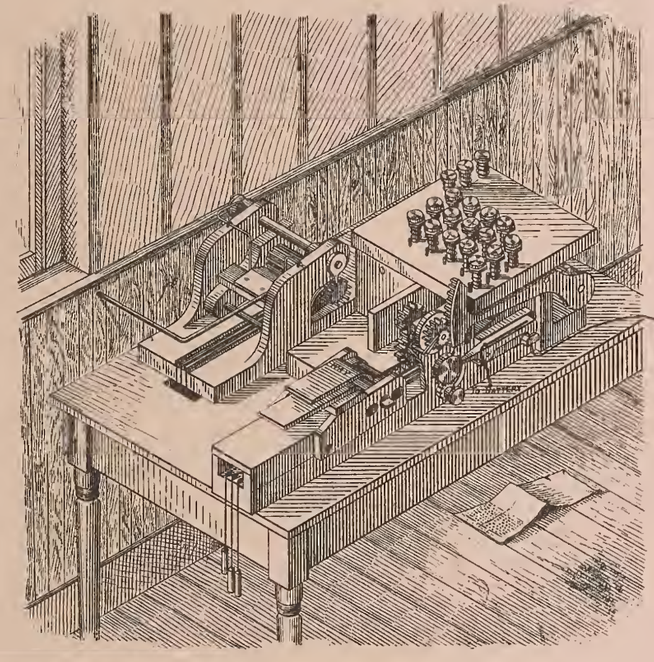
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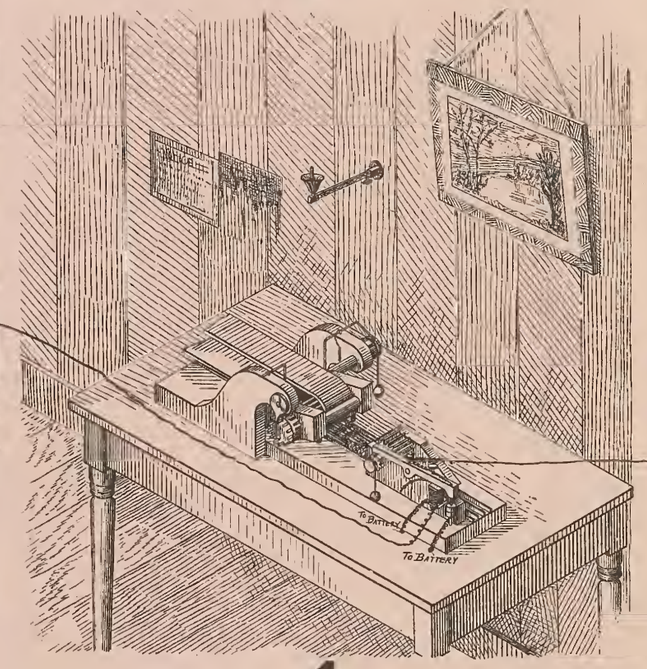


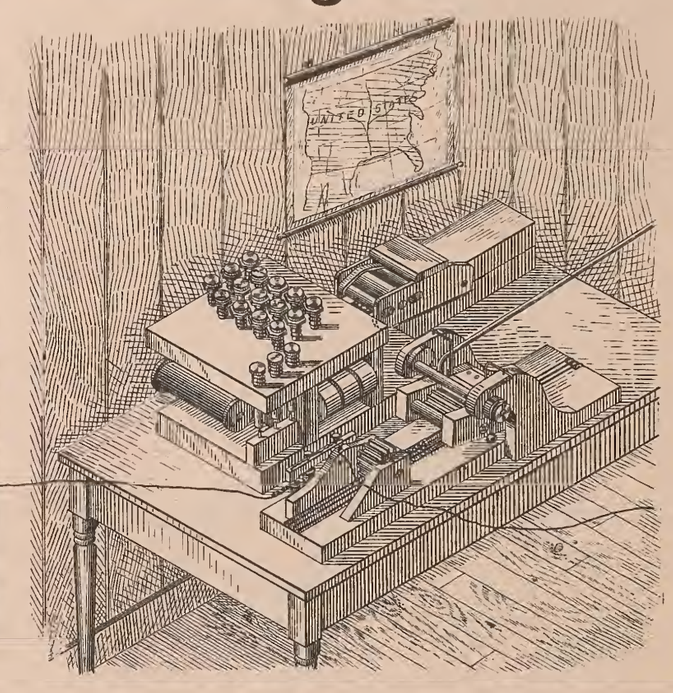
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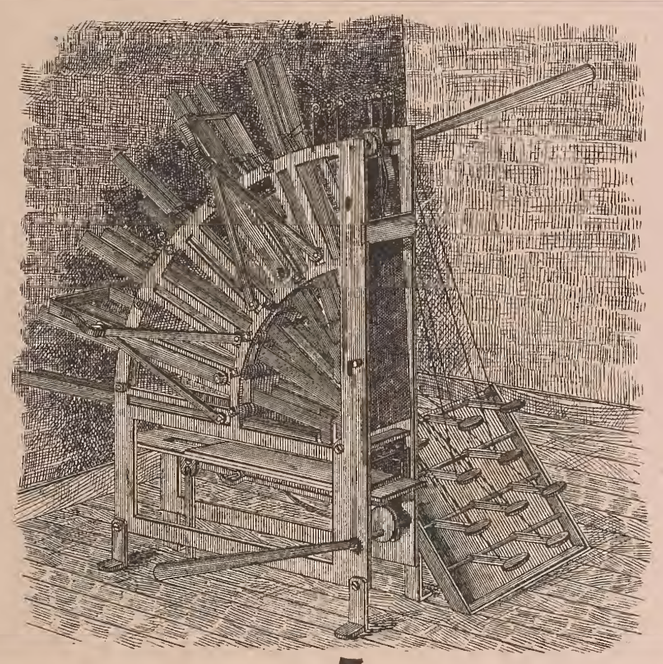
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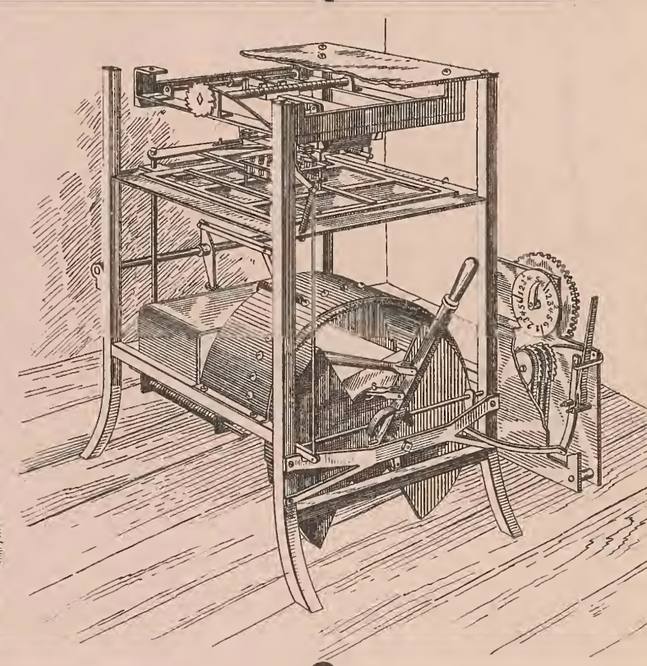




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MATRIX MAKING MACHINES.

MATRIX MAKING MACHINES.

No. 1 U. S. Patent, Type Wheel pressed down by hand—A. D. 1868.
2. " " Box of Type operated by plunger—A. D. 1864.
3. " " Type Wheel revolved by power—A. D. 1867.
4. " " Electrically connected machines for producing duplicate line matrices at several distant points—A. D. 1872.
5. " " Type Rods aligned by finger keys—A. D. 1879.
6. " " Movable Type in movable carrier—A. D. 1880.
7. " " Continuously rotating Type Cylinder—A. D. 1883.

The first person mentioned as practicing the modern art of stereotyping was a Dutchman, Van der Mey, who resided at Leyden about the end of the sixteenth century. He printed four books from solid plates; but at his death the art of preparing solid blocks was lost or wholly neglected. In 1725, however, Mr. Ged, a jeweler, of Edinburgh, apparently without knowledge of Van der Mey's performances, devised the plan of printing from plates; in 1729 he entered into partnership with three other persons, for the purpose of prosecuting the art. A privilege was obtained by the company from the University of Cambridge to print Bibles and prayer-books; but one of Ged's partners was so averse to the success of the plan that he engaged such people for the work as he thought most likely to spoil it. The compositors willfully made errors in correcting, and the pressmen battered the plates when the masters were absent. In consequence, the books were suppressed by authority, and the plates melted. Mr. Ged, with the help of his son, whom he had apprenticed to the printing trade, actually produced, in 1736, an 18mo edition of Sallust; and in 1742 another book was also printed in Newcastle. But after the death of Ged and his son the art again fell into disuse, till in 1780 it was revived by Mr. Tulloch, of Glasgow, who practiced it in partnership with Mr. Fonlis the University printer.

It is difficult to determine who is entitled to the honor of priority.

The first who ever revivified metals from their solutions by voltaic electricity, was an Italian named Brugnotelli, who, in 1805, thus gilded a silver medal. Thirty-four years after, Professor Jacobi, of St. Petersburgh, made a slight advance in the art, by converting any line into relief by a galvanic process. In the same year Mr. Jordan, a London printer, discovered a method of making copper casts by the deposition of copper from its solution, slightly forestalling Mr. Spencer, a carver and gilder, of Liverpool, who, in the autumn of that year exhibited to the British Association several more perfect specimens of electrotyping.

The first electrotyping in America was done by Mr. Bruce, of New York City, in 1813, who printed a catechism, which it is believed was the first book issued from stereotype plates in this country.

A U. S. patent was granted during 1877 for a method of rapid telegraphing of stereotype plates. It is claimed that by this process an entire page of a newspaper can be transmitted by telegraph in from fifteen to thirty minutes, delivering the copy directly from the instrument in such form that it can be handed immediately to the printers. In other words the copy will be a substantial reproduction of the original, except that it may be given in a larger letter if so desired.

The stereotype plate requires no preparation for the purpose of telegraphic transmission other than the filling of all its depressions or spaces between the faces of the letter with a non-conducting substance, which may be quickly applied, the faces of the type being left clean by means of an equally simple process. The plate thus prepared is placed upon a cylinder arranged to revolve rapidly, so as to present each successive letter in fingers attached to a travelling frame. As the cylinder bearing the plate revolves, the frame gradually advances by the operation of a screw, and thus each and every type is successively presented to the fingers or magnetic points above mentioned.

Necessarily the circuit is open when the points are passing over the non-conducting surface; but as often as the metal type presents itself to the fingers the circuit is closed, and the corresponding magnetic points or pens at the receiving station make the record there in the same letter as the original, delineated in a series of fine lines, either upon chemically prepared or ordinary paper fixed upon a corresponding cylinder at the receiving station.

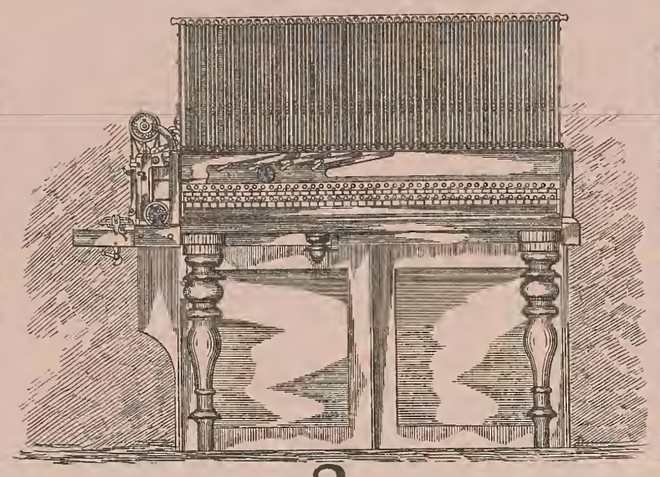
MATRIX MAKING MACHINES.

40 Patents Granted by the United States.

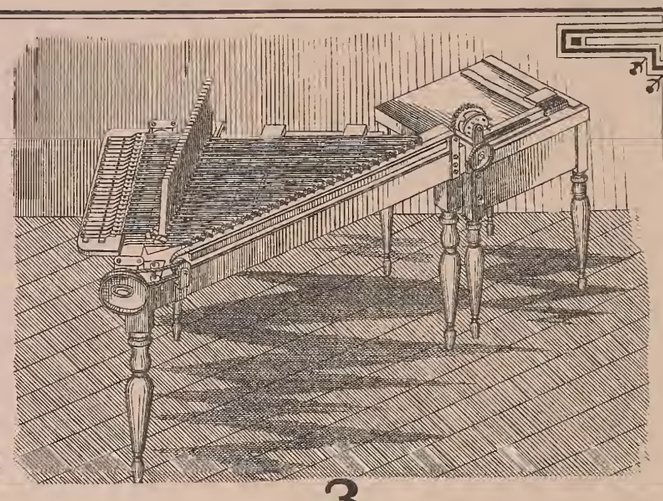
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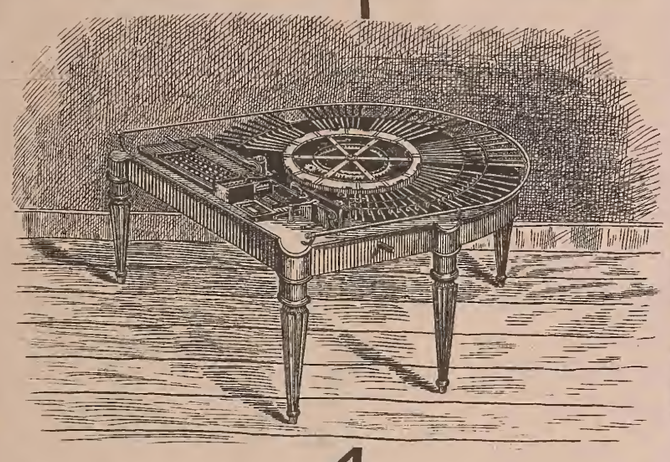
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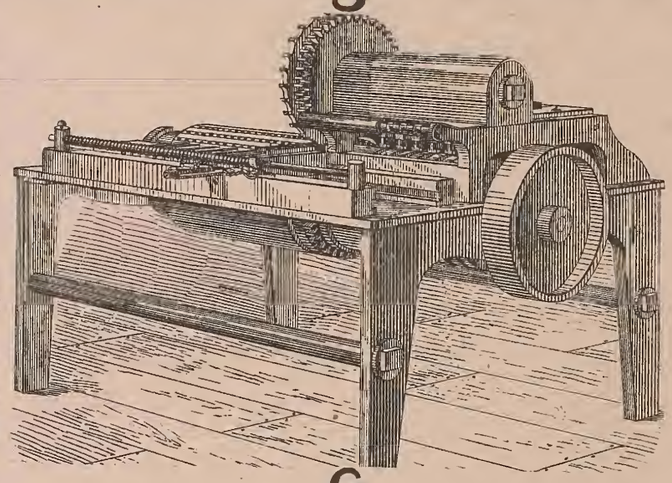
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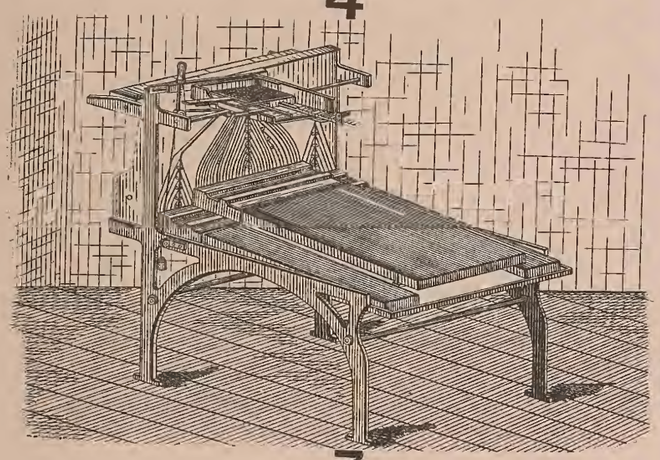
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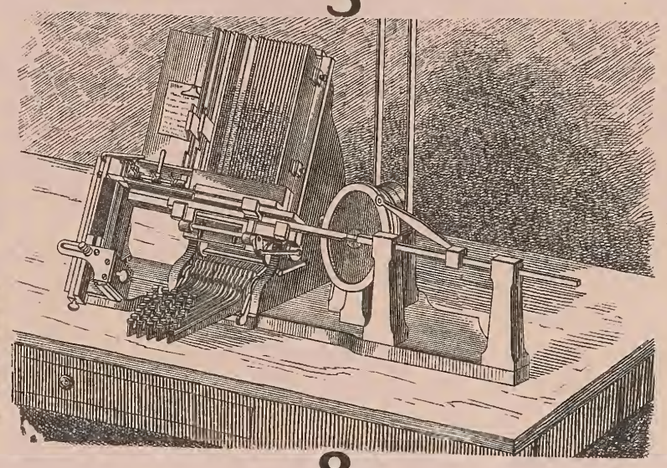
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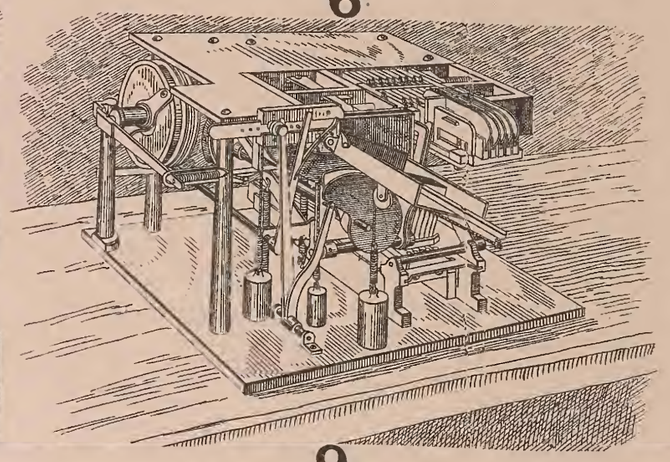
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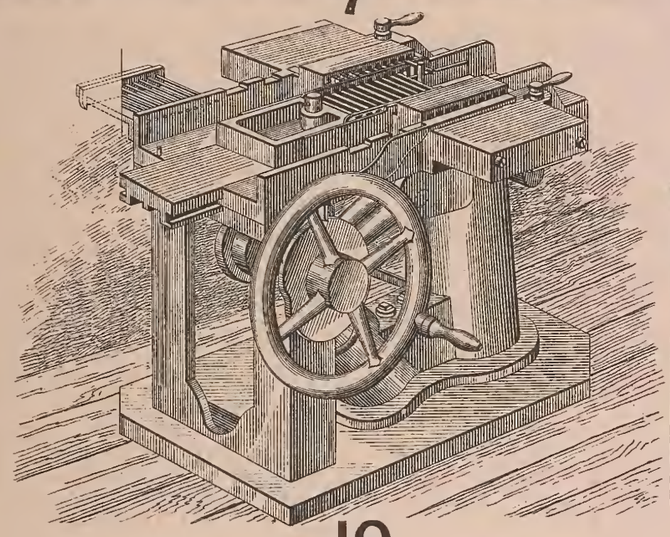
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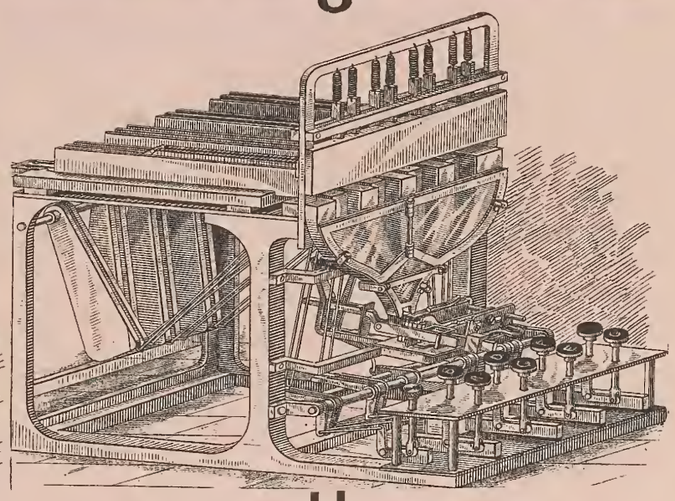
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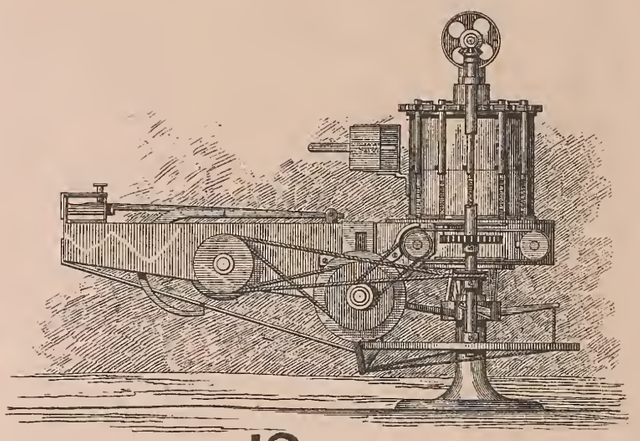
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TYPE SETTING AND DISTRIBUTING.

TYPE SETTING AND DISTRIBUTING.

No. 1. Primitive method of Setting Type—16th Century.

2. U. S. Patent, Composing. Throws types on traveling belt from cases—A. D. 1843.

3. " " Composing. Separate belts carry types from cases to diagonal collecting belt—A. D. 1853.

4. " " Sets and Distributes simultaneously—A. D. 1857.

5. " " Moves stick to desired case and ejects type thereinto—A. D. 1872.

6. " " Composing. Types in longitudinal grooves in revolving cylinder—A. D. 1873.

7. " " Distributing. Keys operate switch blocks leading types to proper case—1878.

8. " " Composing. Keys throw corresponding ejectors into path of revolving blade—A. D. 1874

9. " " Distributing. Feelers engaging with nicks in types, throw them in proper receptacles—A. D. 1876.

10. " " Distributing. Types register with openings in cases. Pneumatic plungers—A. D. 1878.

11. " " Composing. Types ejected into ways converging to common channel leading to galley—A. D. 1880.

12. " " Sets and Distributes. Combines features analogous to Nos. 8 & 10—A. D. 1880.

It is now about fifty years since the first type-setting apparatus was invented, and a thoroughly successful machine has not yet been introduced. Great hopes have been formed from time to time, as one machine after another has been announced, and several of these have done very fair work.

As mechanical contrivances they have been quite ingenious, and have worked with a degree of precision which made us think again and again that the goal had been reached at last, and yet to-day but few such machines are in use, and they only on a class of plain work where the number of sorts is limited.

A machine must, of course, include capitals, lower-case, points and figures; it cannot be very efficient without small capitals and italics, but each addition to its capability for variety of work adds greatly to its complexity.

After all, it is a race between traveling from the stick to the boxes of the case and back again, and fingers beating upon the keys of the machine. The latter would, of course, carry the day, as the average travel of the hand after a letter is twelve inches from the stick, and the travel on the key-board of the machine is considerably less than one-half this; but there are so many little niceties to be observed in spacing the words and justifying the lines—work which is done by the skillful printer as he sets up the line, but which, with machine-set type must be done afterwards, when the line of type is broken into lengths for the measure of the work and then justified by spaces.

Type-setting machines have separate pockets or galleys for each sort, and the mechanical arrangement is such that on touching the key, arranged with others like the key-board of a piano or concertina, the end type of the row is displaced and is conducted in a channel or by a tape to a composing stick, where the types are arranged in regular order in a line of indefinite length, whence they are removed in successive portions to a justifying stick, in which they are spaced to the proper length of line required.

Three machines of this character were exhibited at the Paris Exposition in 1855.

Of the American machines, that of Alden has, perhaps, excited most attention.

The persistence of the inventor for seventeen years in the endeavor to perfect his invention, and his death in 1859, when success appeared to be crowning his efforts, afford one more interesting item to the history of invention when it shall be written.

His machine has types arranged around the circumference of a horizontal wheel which rotates slowly, carrying with it fingers which pick up the proper types from their respective cells. The ordinary types are used, with the exception that each has its peculiar nick at one side, which will enable the fellow-machine to discriminate when distributing the type.

In the distributing process the dead matter is placed on a bed to the right of the key cylinder, and is taken up line by line as each is exhausted. The types are taken up by distributing transits in the revolving wheel, selected by means of the nicks, and then transferred by way of the channels to the respective type pockets. Extra spaces are tipped out at the end of the channel. Unnicked type are thrown into a separate box, italics into another.

In the Kastenbein composing machine common type are used, each sort being arranged vertically in a series of tubes like the pipes of an organ. As a letter key of the key-board is struck, the lever connecting with the particular letter tube opens the lower end of the tube and allows the lowest type in the rank to fall into a groove which conducts it to the slide where the letters are assembled in a long line, whence they are taken by the compositor's rule and justified.

The distributing machine reverses this method. The dead matter is placed on a bed, each line is cut off, and the types raised *seriatim* so that they can be read by the observer. The corresponding key on the key-board being depressed, the type is pushed into its appropriate tube, ready for supplying the composing machine.

Printers have been wont to boast that a practical type composing and justifying machine presents a problem which even Yankee ingenuity and persistence could not solve; but in view of the progress made in this direction during the last decade, it can hardly be doubted that complete success will be achieved in the near future.

Still later machines for composing and distributing, the invention of Mr. Paige, were recently exhibited in New York, and worked well.

It remains, however, to be determined whether or not the capital invested in them and the casualties incident to complicated and delicate machinery will discourage their use in place of compositors, who own themselves, are always ready, and for whom substitutes can be found if one or another prove ailing or erratic.

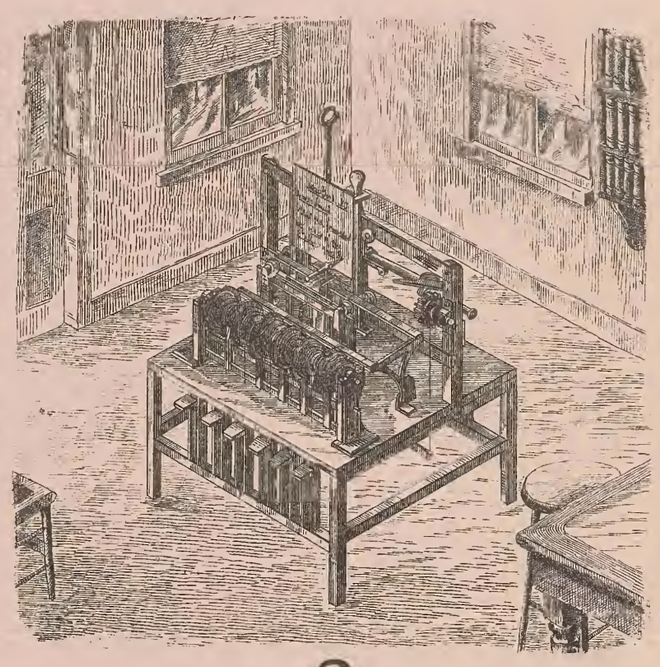
TYPE SETTING AND DISTRIBUTING.

125 Patents Granted by the United States.

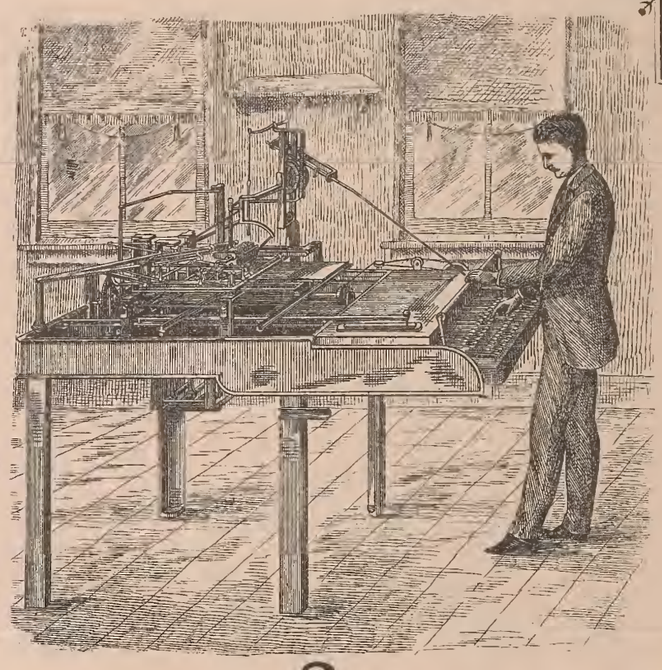
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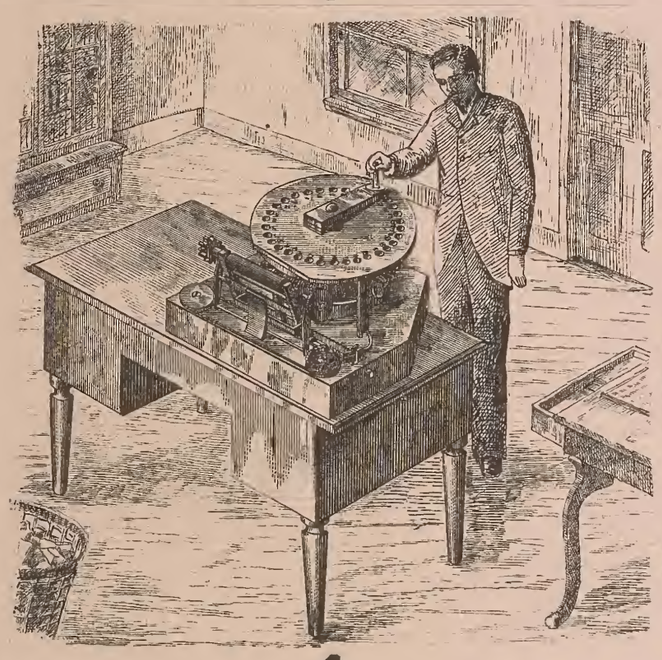
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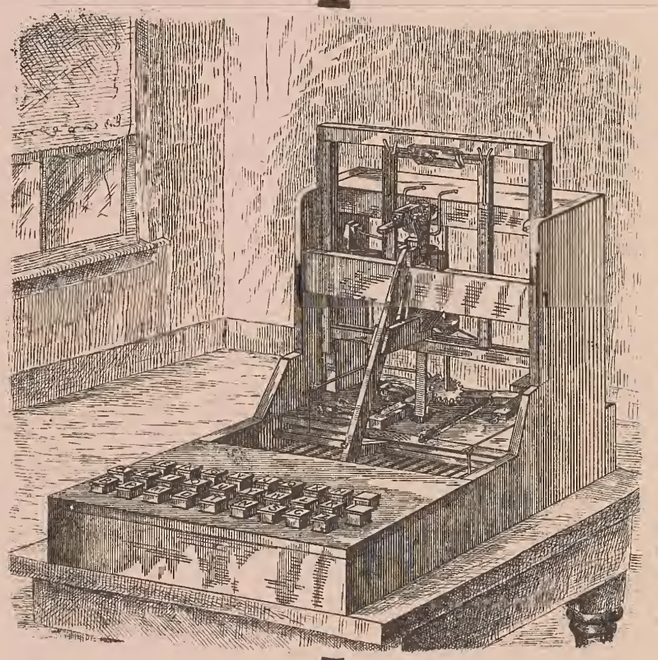
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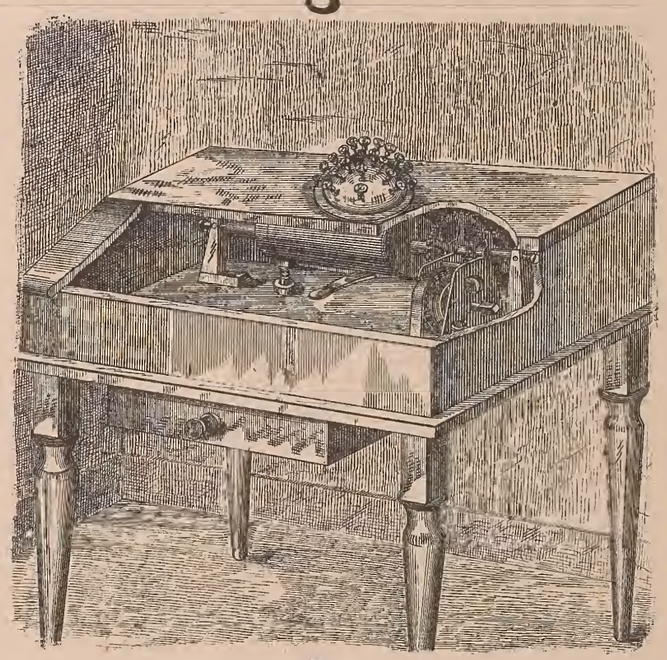
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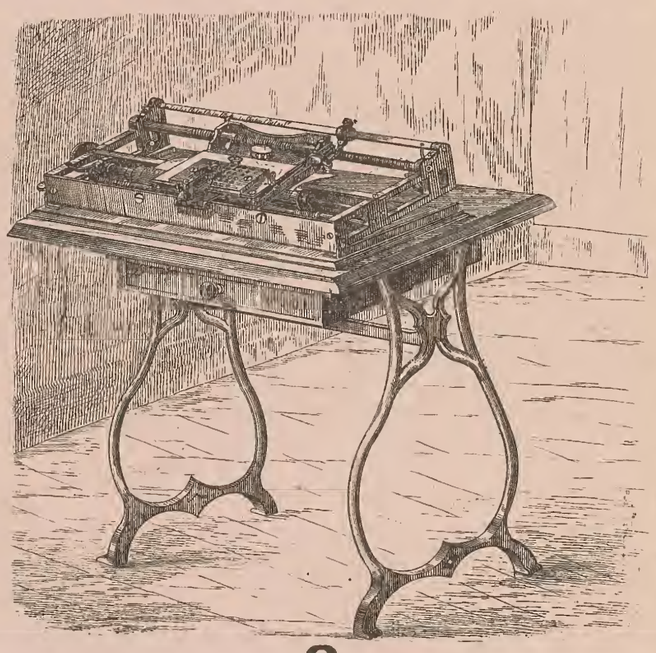
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TYPE WRITERS.

TYPE WRITERS.

No. 1. Hand Writer.
2. U. S. Patent, Connected Pencil, Traces Letters—A. D. 1845.
3. " " Double Hand Impression Machine—A. D. 1850.
4. " " Type Wheel Machine—A. D. 1856.
5. " " Movable Type Plate and Hammer—A. D. 1868.
6. " " Spring Seated Keys Carry Type—A. D. 1872.
7. " " Type on ends Lever—A. D. 1878.
8. " " Elastic Type Plate—A. D. 1881.
9. " " Oscillating Type Segment & Hammer—A. D. 1884.

The type-writer is generally supposed to be a machine of recent invention, but it really dates as far back as 1714.

The archives of the British Patent Office show the issue of a paper on January 7, 1714, No. 395, to Henry Mill, of England, for "an artificial machine or method for the impressing or transcribing of letters, singly or progressively, one after another, as in writing, whereby all writings whatsoever may be engrossed on paper or parchment so neat and exact as not to be distinguished from print; that the said machine, or method, may be of great use in settlements and public records, the impression being deeper and more lasting than any other writing, and not to be erased or counterfeited without manifest discovery, &c."

The records of the U. S. Patent Office show that letters patent were granted William A. Burt, of Detroit, Michigan, for a machine for printing, styled by himself the "typographer," July 23, 1829.

This patent is said to be still in existence, but the records, other than above, were destroyed in the fire of 1836.

In the year 1843 Charles Thurber, of Worcester, Mass., secured letters patent for a type-writing machine, but his invention did not possess the merits to recommend it, and was soon put aside.

One of the earliest patents granted was that of A. E. Beach, June 24, 1856, for printing instruments.

Among the earliest forms was the invention of S. W. Francis, who received letters patent October 27, 1857, for a writing machine which contained nearly all the features of subsequent devices in this line of inventions. "The Francis" was a complicated machine which has been much simplified by later inventions.

Amongst the best known type-writers now in general use are the Remington, Caligraph, and Hammond.

To such perfection has the machine been brought that even the most detailed and intricate statement, containing column after column of figures, can be readily made with it, and in a neat and business like form that is impossible with the pen of an average writer. Its use has opened a field for women who have to earn their living that never existed before. They are naturally expert and skillful in using the fingers, and they readily learn to use the type-writer with great speed. A number of schools have added it to their regular course, and young men who learn to use it find it far easier to obtain situations.

TYPE WRITERS.

23,000 Manufactured Annually.

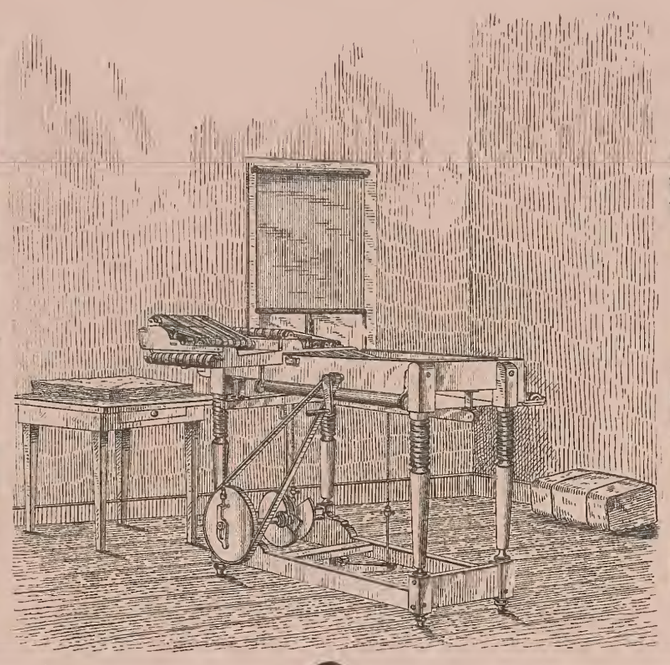
Capacity—	Primitive Mode.	Present Machine.
Words per minute,	50	100
Hands Employed per day,	1	1

152 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



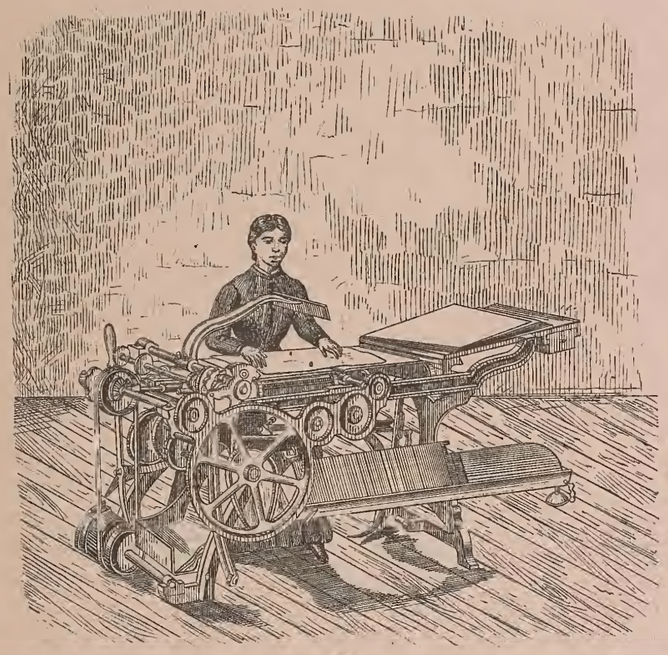
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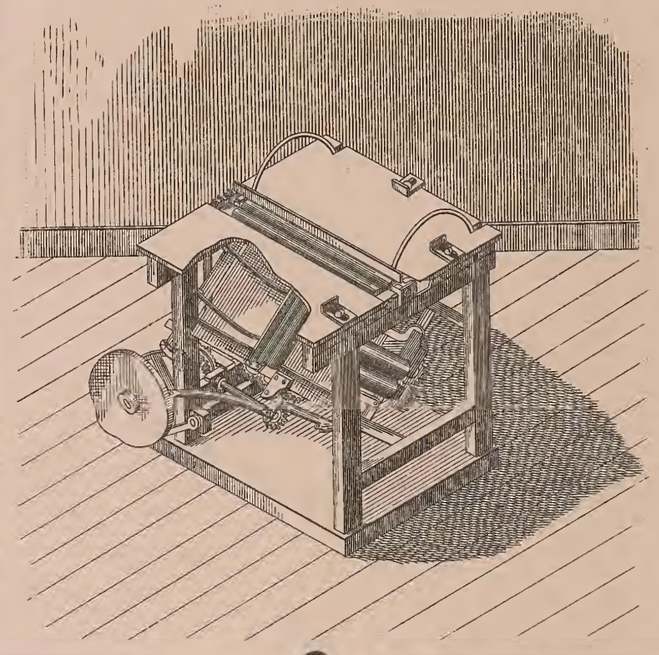
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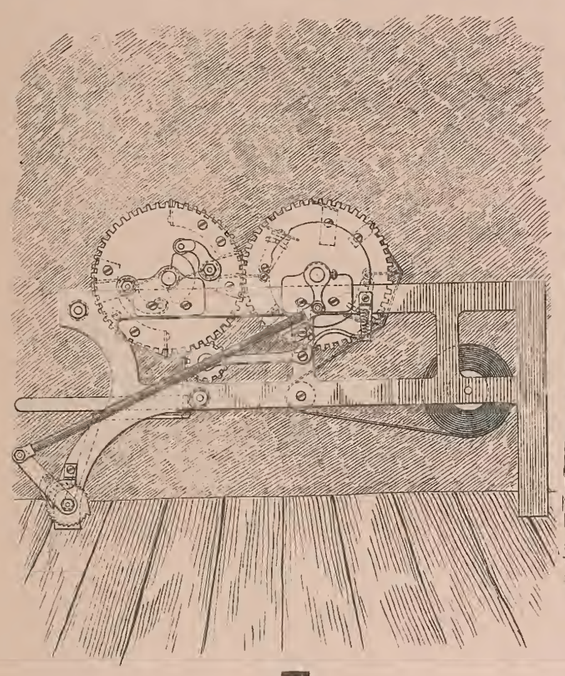
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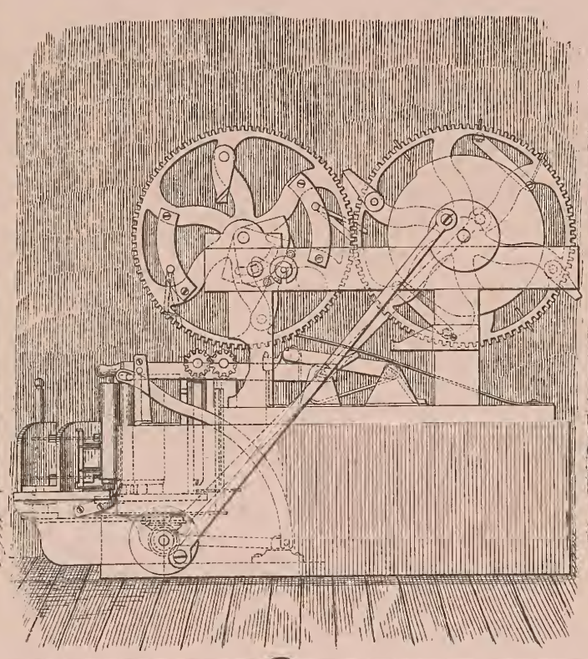
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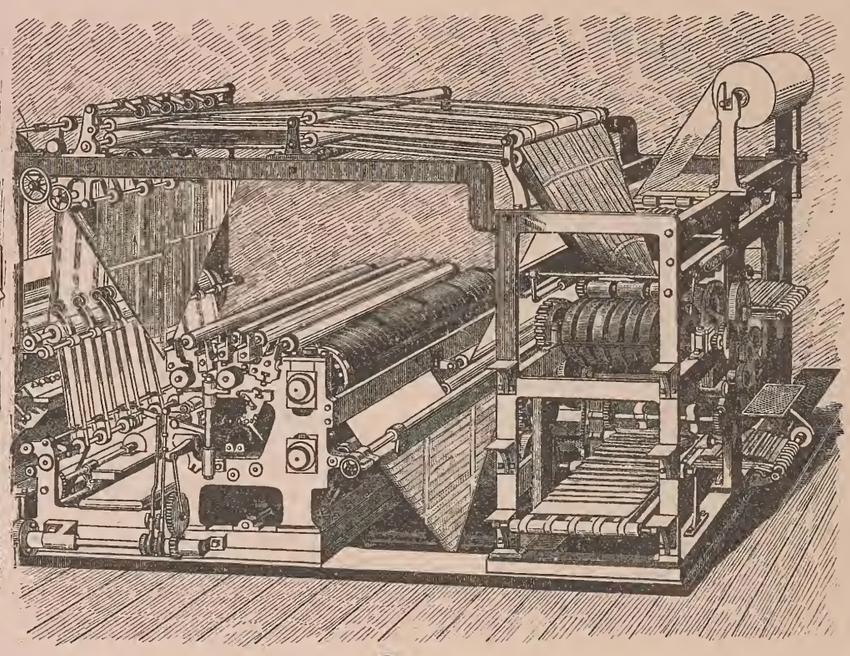
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PAPER FOLDING MACHINES.

PAPER FOLDING MACHINES.

No. 1. Folding by Hand.
2. U. S. Patent Reciprocating Blades, Tape Feed—A. D. 1849.
3. " " " " Fixed Ways—A. D. 1850.
4. " " Oscillating Blades, Register Points—A. D. 1856.
5. " " Insert cut from sheet and folded in—A. D. 1860.
6. " " Sheets Slide on Inclined Tables—A. D. 1861.
7. " " Rotary Folder—A. D. 1873.
8. " " " " —A. D. 1877.
9. " " Longitudinal and Rotary Folders—A. D. 1883.

Machines for folding newspapers and sheets for books follow naturally in the wake of the printing press. They are made of various kinds, for octavo, 16mo., and 32mo.; also for folding 12mo., cutting off, pasting and inserting the inset; in some cases, placing it in a cover and doubling it up into compact shape for the mail wrapper.

The sheet is placed on the table so that two register points pass through two holes in the sheet previously made on the printing press. The folder comes down upon the folding edge, the pins give way, and the sheet passes, double edge first, between a pair of rollers, which compress it; tapes deliver it to a second table beneath, where a second and a third folder act upon it in turn and deliver into a trough at the rate of 1,500 per hour.

With 12mo. work, imposed in two parts of sixteen and eight pages, respectively, the machine cuts them apart and folds the larger part like an octavo; the smaller folds but once, and is then "inset" into the octavo portion, which forms the "outset."

The two-sheet folder and paster, for large twenty-four-page periodicals, folds one sheet of sixteen pages, 30¼ by 45¼ inches, insetting the eight pages within the sixteen, and pasting and trimming all, delivering a complete copy of twenty-four pages, ready to read, at the rate of 1,200 per hour. It will fold eight pages alone, with or without pasting or trimming, or will fold, paste and trim the eight pages, insetting without pasting them in.

Machines of this general character are also made for folding, pasting and trimming, or for folding, pasting, trimming all around, and putting on a cover of different colored paper.

"The Christian Union" is folded, inset and covered in this manner, four of these machines being attached to a four-cylinder "Hoe" press.

Gallaher, of Washington, D. C., completed the first paper folding machine in 1843, and deposited a model in the U. S. Patent Office.

Birchall, of England, took out letters patent in 1847; Smith's patent of 1849, Snow, 1850, Chambers, 1856, Crosby, 1856, Worth, 1858, had registering pins to fit the perforations made by the printing press.

Ford's patent, 1872, a combination of a folding machine with a printing press, is arranged so that the flyer of the press will deposit the papers upon tapes, instead of on tables.

PAPER FOLDING MACHINES.

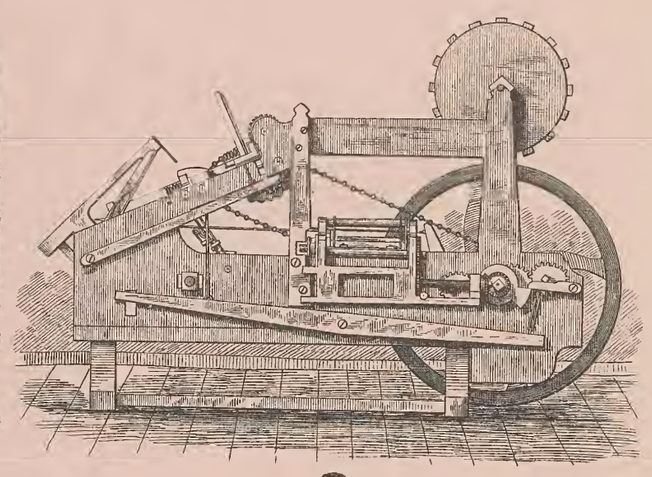
Capacity—	Primitive Mode.	Present Machine.
Average No. copies per day, 16 pp. 8vo.,	2,500	15,000
Hands Employed per day, . .	1	1

161 Patents Granted by the United States.

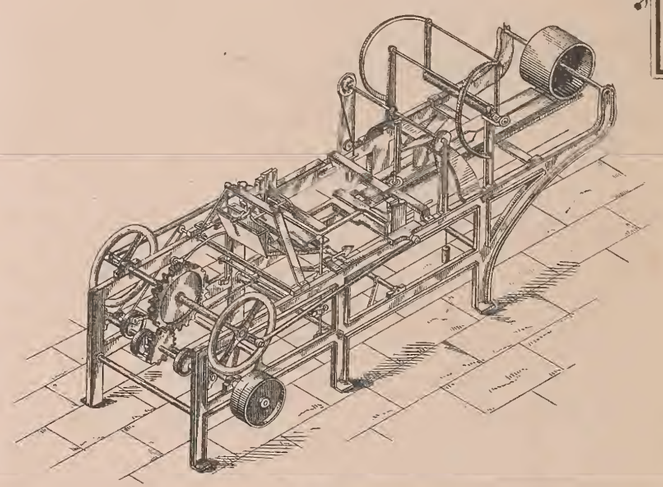
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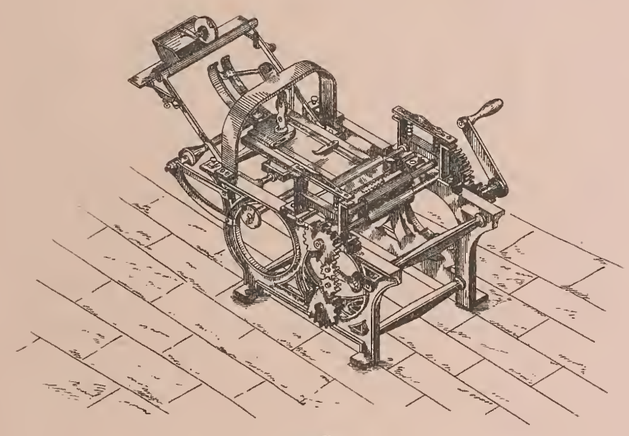
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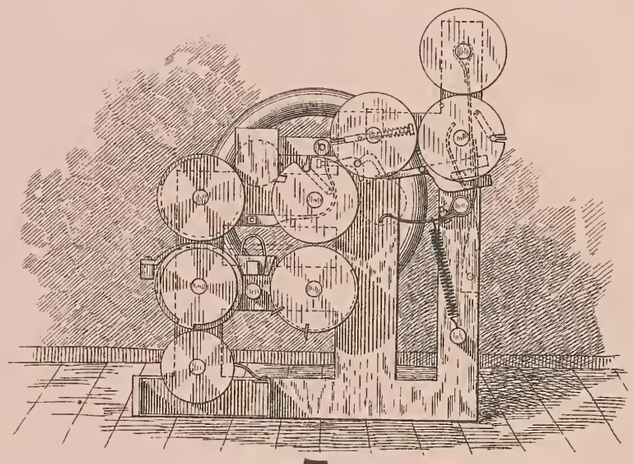
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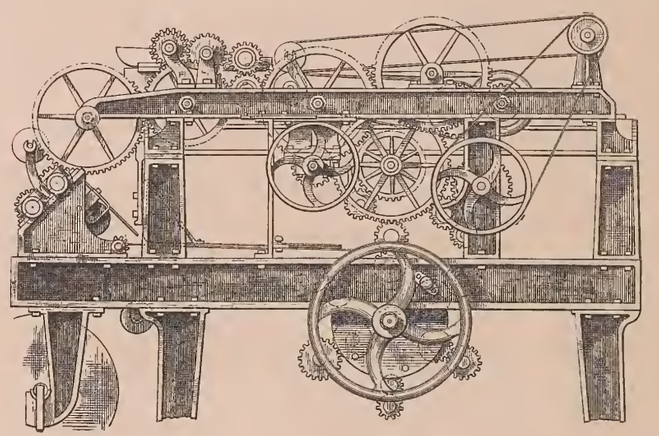
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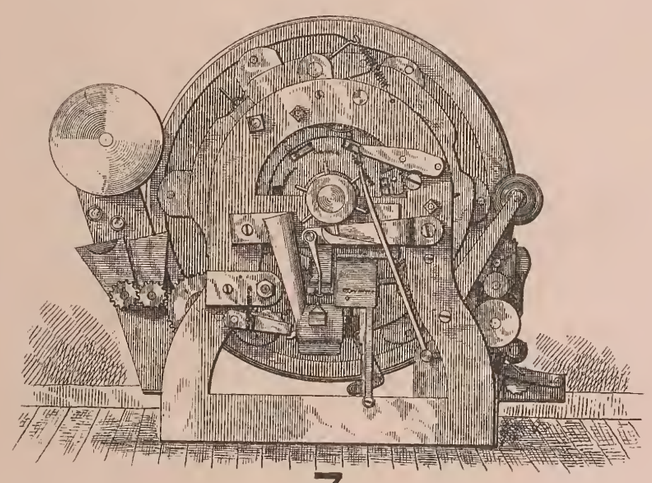
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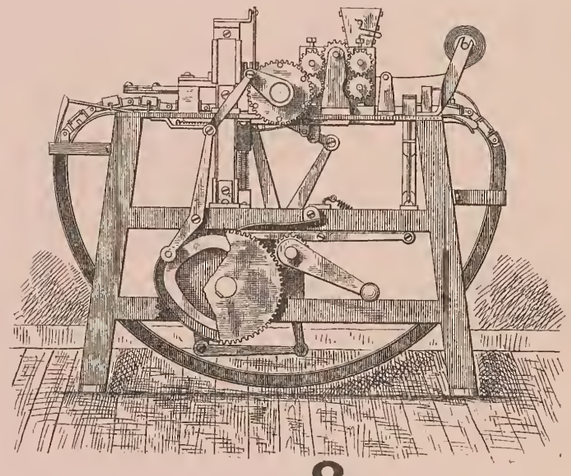
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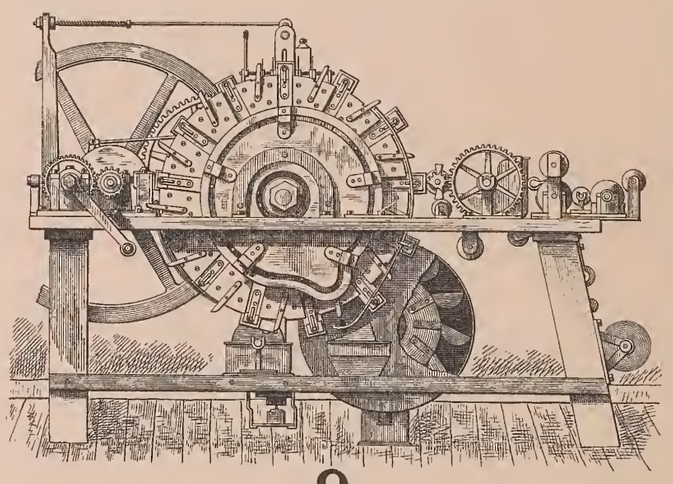
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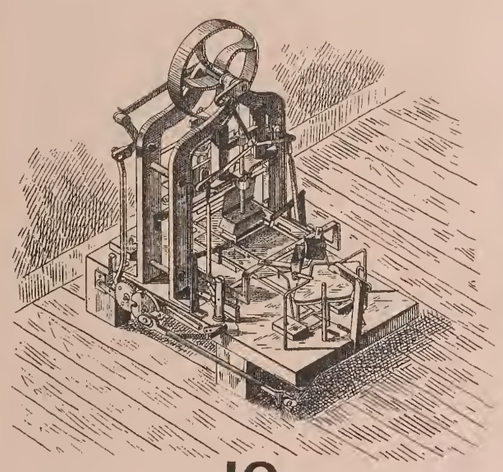
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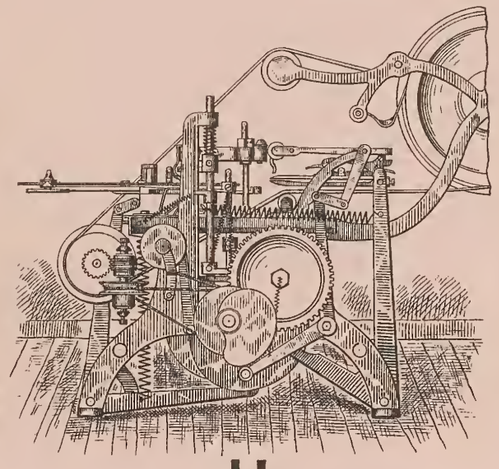
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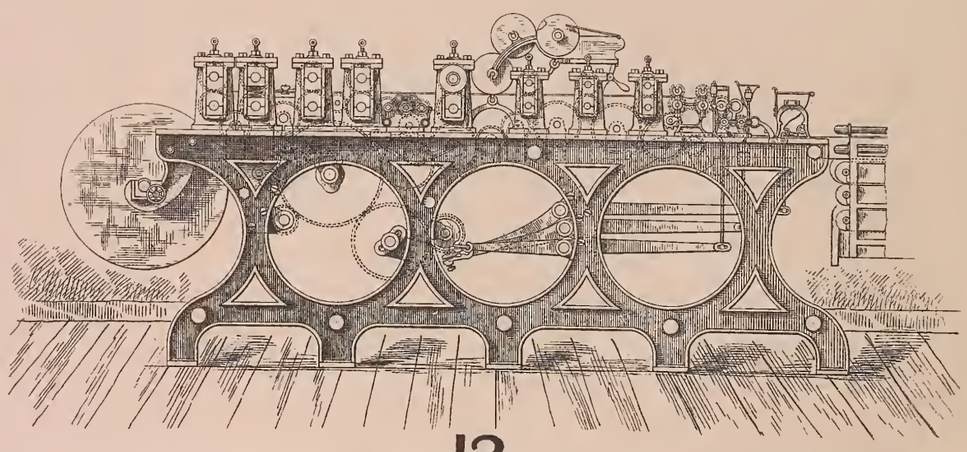
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12

PAPER MANUFACTURES.

No. 1. Primitive Hand Paper Bag Making.
2. U. S. Patent, Paper Bag Machine—A. D. 1852.
3. " " Envelope " —A. D. 1853.
4. " " Paper Box " —A. D. 1855.
5. " " " Bag " —A. D. 1860.
6. " " " Box " —A. D. 1870.
7. " " " Bag " —A. D. 1871.
8. " " Envelope " —A. D. 1871.
9. " " Paper Bag " —A. D. 1879.
10. " " " Box " —A. D. 1882.
11. " " " Bag " —A. D. 1882.
12. " " Envelope " —A. D. 1883.

PAPER MANUFACTURES.

The old method of folding envelopes was by means of the bone folding stick. A good workman could produce by its aid 3,000 envelopes a day.

Pierson commenced the manufacture of envelopes in this country in 1843, but became discouraged and gave up the business.

Jacob Berlin followed him three years later. He was successful, and the trade in the United States was firmly established.

They are now chiefly made in New York, New England and Pennsylvania.

At the present time the number manufactured in this country reaches 10,000,000 per day. These are consumed principally in the United States. Some are sent to Canada, South America, Mexico, West Indies and Australia. At one time shipments were made to Liverpool. Now they are buying our improved machinery and are manufacturing themselves.

Many envelopes of American manufacture are sent to Russia and other foreign countries. With our improved machinery and cheap paper we can successfully compete with any foreign country.

Until the invention of this machine the manufacture of envelopes was by no means perfect. Improvements have been going on constantly since the Japanese first used envelopes as inclosures for perfumes, etc.

The contractors for the postal stamped envelopes use the "Leader" machine with an attachment, which prints and stamps the envelopes at the same time at the rate of about 2,000 an hour.

It is now a common thing to speak of paper bottles, buckets, wheels, rails, carriages, roofs, soles, hats, chimney stacks, and innumerable other articles made of paper.

Paper railroad ties are now a practical reality. In their manufacture the paper is subjected to great pressure, and it is said the material can be produced at one-third the cost of steel rails.

A man to-day can wear paper shoes and clothes, eat from paper dishes, with paper knives and forks, served upon a paper table, sit on a paper chair, sleep in a paper bed, in a room carpeted with paper, wash in a paper tub or bowl, live in a paper house, ride in a paper carriage or car, sail in a paper boat, make a fortune on paper, and yet the industry is only in its infancy.

There are three factories in the United States making petroleum barrels from paper which turn out 3,000 barrels a day.

PAPER MANUFACTURES.
BAG, BOX AND ENVELOPE.

80 Manufactories of Paper Bags in the United States.

	1860	1880
Capital Invested,	$82,000.00	$1,304,700.00
Value of Productions,	749,578.00	4,112,566.00
Wages Paid,	43,968.00	439,620.00
Hands Employed,	112	1,569

369 Manufactories of Paper Boxes in the United States.

	1860	1880
Capital Invested,	$333,196.00	$2,496,496.00
Value of Productions,	1,162,777.00	7,665,553.00
Wages Paid,	358,658.00	2,373,948.00
Hands Employed,	1,601	9,678

12 Manufactories of Envelopes in the United States.

	1860	1880
Capital Invested,	$309,600.00	$923,800.00
Value of Productions,	763,700.00	3,000,617.00
Wages Paid,	117,180.00	344,143.00
Hands Employed,	432	1,204

1,603 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



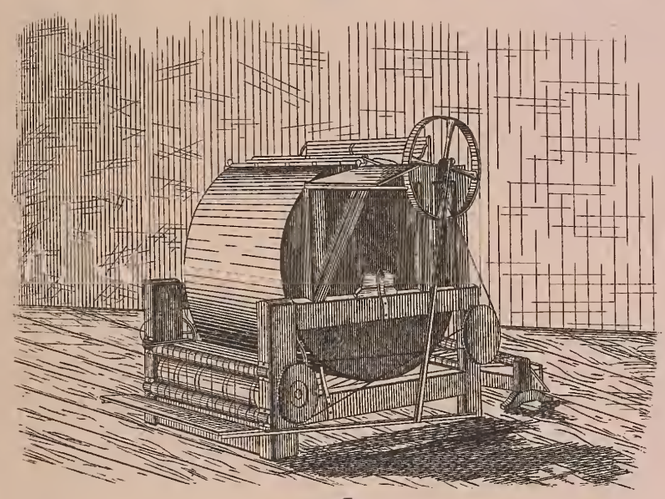
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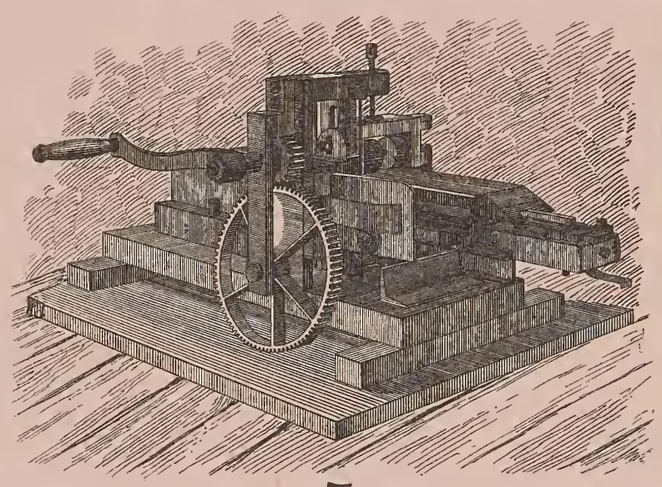
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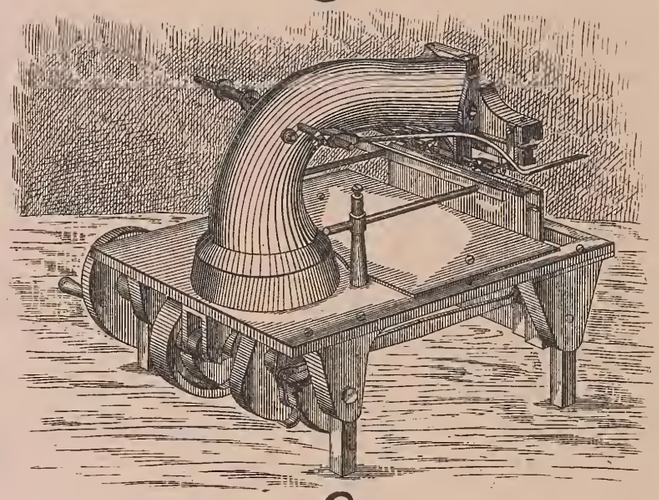
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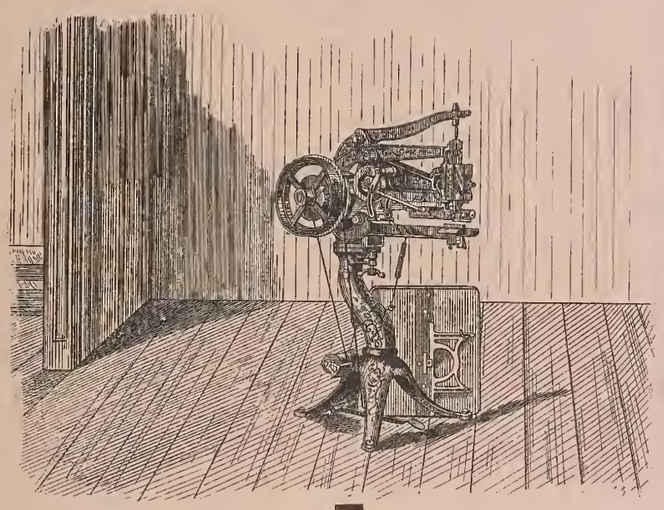
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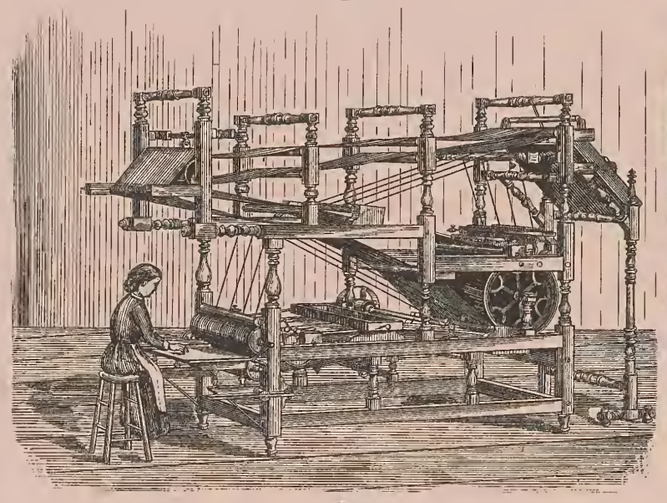
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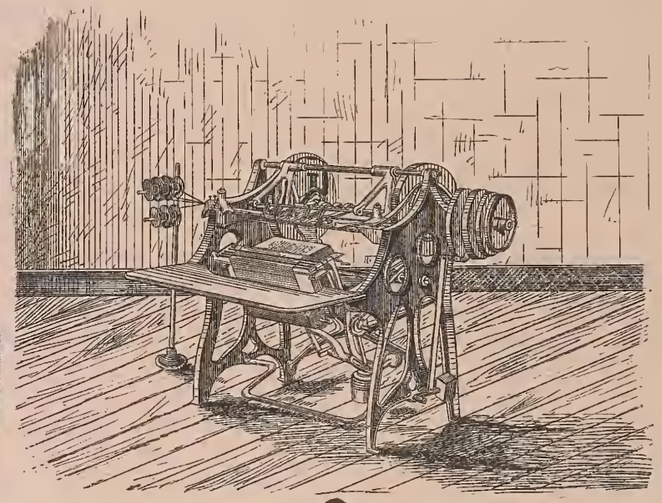
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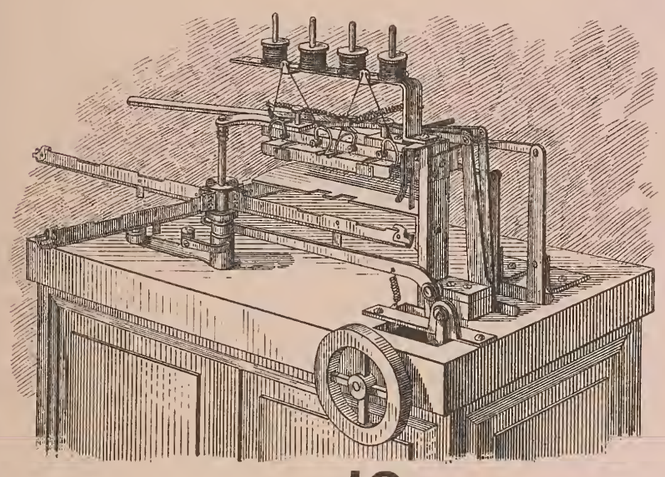
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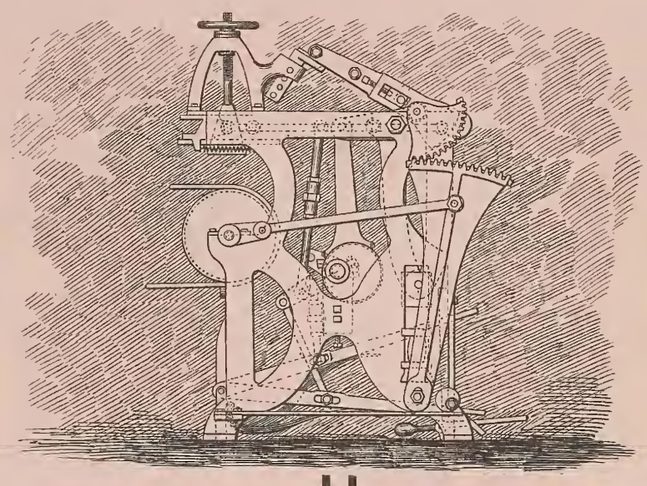
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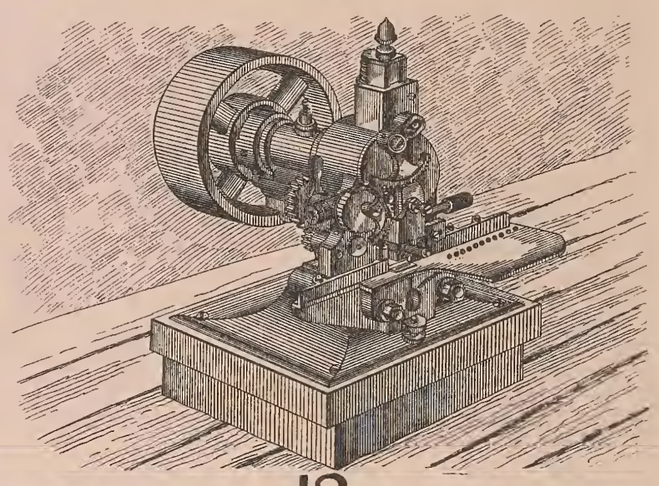
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BOOK BINDING AND PAPER RULING.

BOOK BINDING AND PAPER RULING.

No. 1. Hand Book Sewing.
2. " Ruling.
3. " Rounding Books.
4. U. S. Patent, Hand Ruling Machine—A. D. 1882.
5. " " " Rounding Machine—A. D. 1845.
6. " " " Single Thread Book Sewing Machine—A. D. 1870.
7. " " " " Wire Book Stapling Machine—A. D. 1875.
8. " " " Ruling Machine—A. D. 1877.
9. " " Several Wires Book Stapling Machine—A. D. 1877.
10. " " " Thread Book Sewing Machine—A. D. 1879.
11. " " Automatic Book Backing Machine—A. D. 1881.
12. " " Single Wire Book Stapling Machine—A. D. 1882.

Book-binding is coeval with the art of composing books, for, from whatever materials ancient books were made the necessity arose of uniting the several parts for more ready reference, as well as for their better preservation.

The earliest known form is the Egyptian, which consisted in pasting or gluing the sheets together and rolling them upon small cylinders; the sheets were unrolled from one cylinder, and, after reading, rolled upon the other.

It is asserted that Phillatius was the discoverer of a substance for making the sheets adhere together.

The plan of fastening the leaves to a back and sides is said to be the invention of Attalus of Pergamus, about 200 B.C. He also first ordered the squaring of books. This is the origin of folding in twos, or fours, or "folios and quartos."

Ivory was used for book covers in the eighth century, and oak in the ninth. The book of the Evangelist on which the English Kings took their coronation oath was bound in oak boards, A. D. 1100.

Hog skin leather, silk, velvet, and calf skin were used as early as the fifteenth century.

In the Bodleian Library is a volume of the Epistles of St. Paul, the binding of which was embroidered by Queen Elizabeth.

Cloth binding superseded the paper known as "Boards" in 1823.

India rubber backs were introduced in 1841, and tortoise shell sides in 1856.

Book-sewing was done entirely by hand until 1872, when Henry G. Thompson, of Connecticut, invented a machine for book-sewing which is still in practical use.

The several modes of binding books are known by the following names:

Full binding is entirely of leather.

Half full has the back and corners of leather, and the sides of cloth or paper.

Cloth binding has the back and sides of cloth.

The kinds of leather with which books are either full or half bound give the names to various bindings, as, Russia, Morocco, Roan, Calf, Sheep, and Vellum.

France, England and America have each characteristically contributed to the improvement in style, design and cheapness of book-binding.

France has excelled in taste, England in solidity and strength, and America, by the invention and use of machinery, has vastly increased the speed and cheapness of production.

BOOK BINDING AND PAPER RULING.

588 Book Binding and Blank Book Making Establishments in the United States.

	1860	1880
Capital Invested,	$1,654,830.00	$5,798,671.00
Value of Productions,	3,729,080.00	11,976,764.00
Wages Paid,	1,048,930.00	3,927,349.00
Hands Employed,	4,777	10,612

BOOK BINDING.

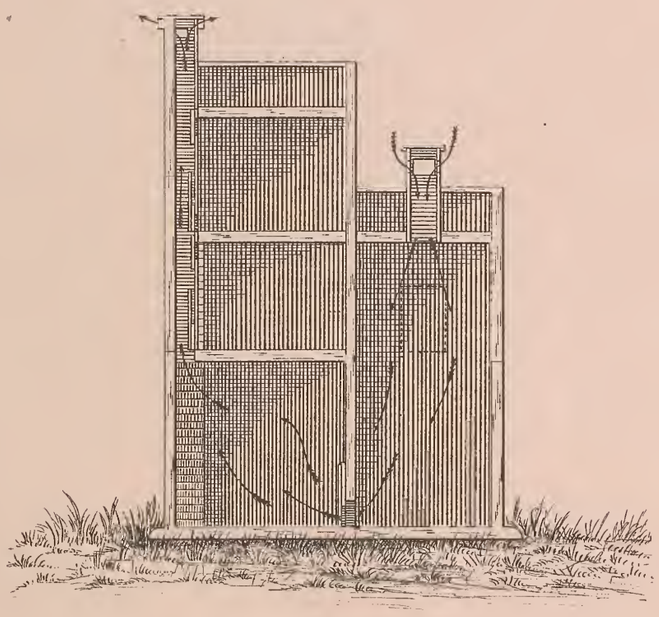
Capacity—	Primitive Mode.	Present Machine.
Completed Volumes per day,	25	250
Hands Employed per day,	1	1

PAPER RULING.

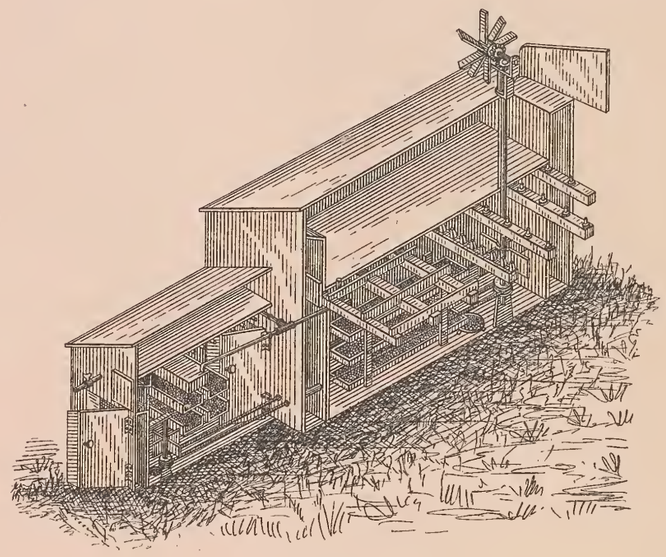
Capacity—	Primitive Mode.	Present Machine.
Sheets Paper per day,	100	20,000
Hands Employed per day,	1	1

923 Patents Granted by the United States.

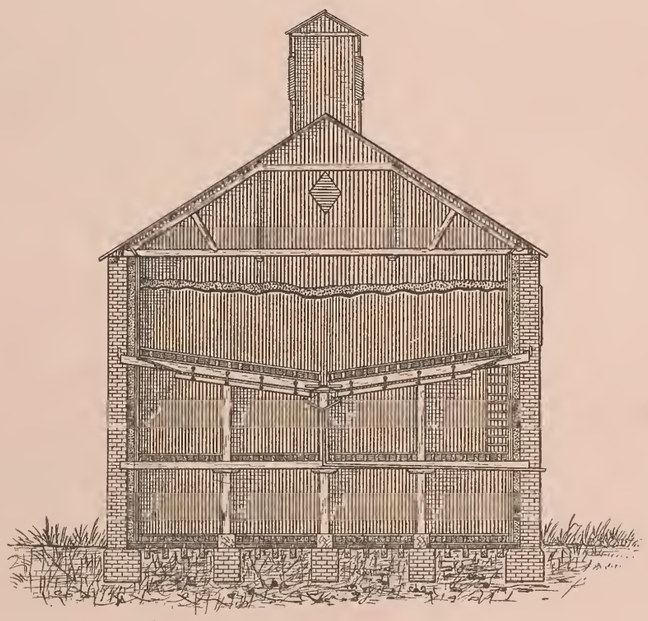
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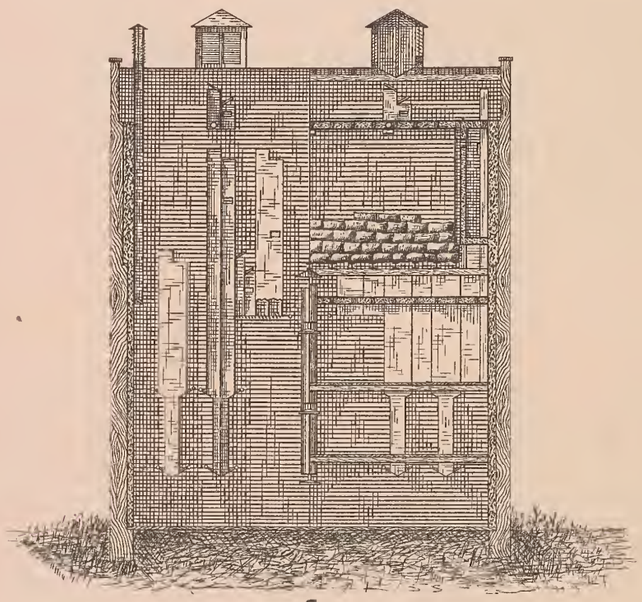
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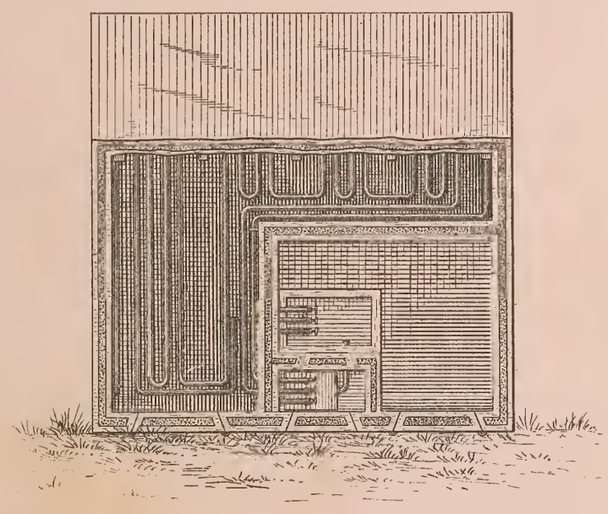
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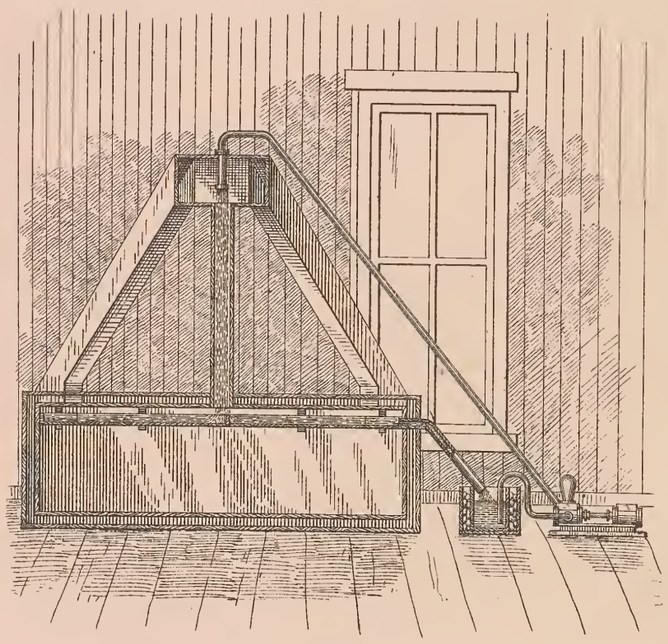
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REFRIGERATOR BUILDINGS.

REFRIGERATOR BUILDINGS.

No. 1. U. S. Patent, Refrigerator Fruit House—A. D. 1855.
2. " " " Building—A. D. 1861.
3. " " " Fruit Preserving House—A. D. 1867.
4. " " " Building—A. D. 1872.
5. " " " Structure—A. D. 1879.
6. " " Cooling Air in Refrigerating Rooms—A. D. 1884.

In the time of Senaca snow, collected from the mountains and, preserved in deep pits, had become an article of merchandise in Rome.

Alexander the Great, when he besieged the city of Patra, caused trenches to be dug which he filled with snow and covered with oak branches to preserve it.

In the 16th century there were no cellars in France.

The use of cellars for storing ice and preserving goods came into existence in England in the reign of Henry VIII.

The Quincy Market Cold Storage Company, of Boston, is said to have the largest refrigerating building in the world. It is of stone and brick, 160 by 80 feet in size, and 70 feet in height. The capacity is 800,000 cubic feet, the cost $200,000, and the ice chamber holds 600,000 tons of ice. It is used for storing dressed beef and mutton. The Chicago refrigerating cars unload at the door.

In the dry atmosphere of the Andes on the California coast, meats may be preserved without artificial means.

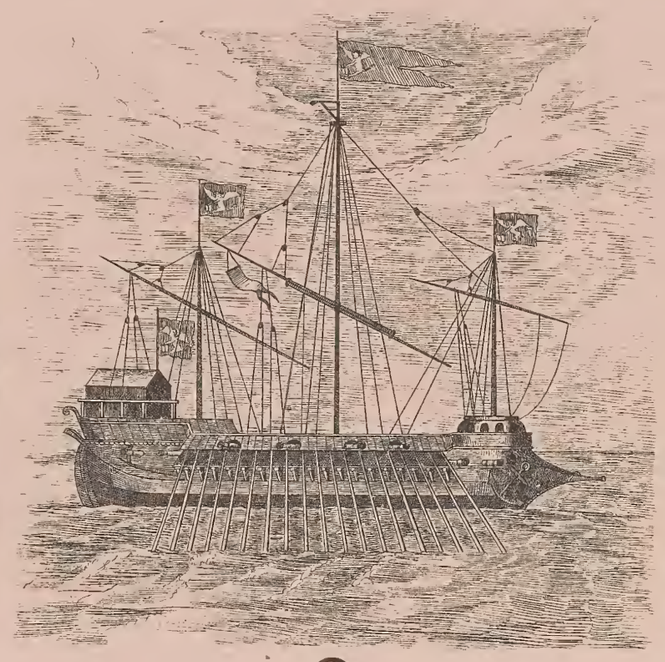
REFRIGERATOR BUILDINGS.

164 Patents Granted by the United States.

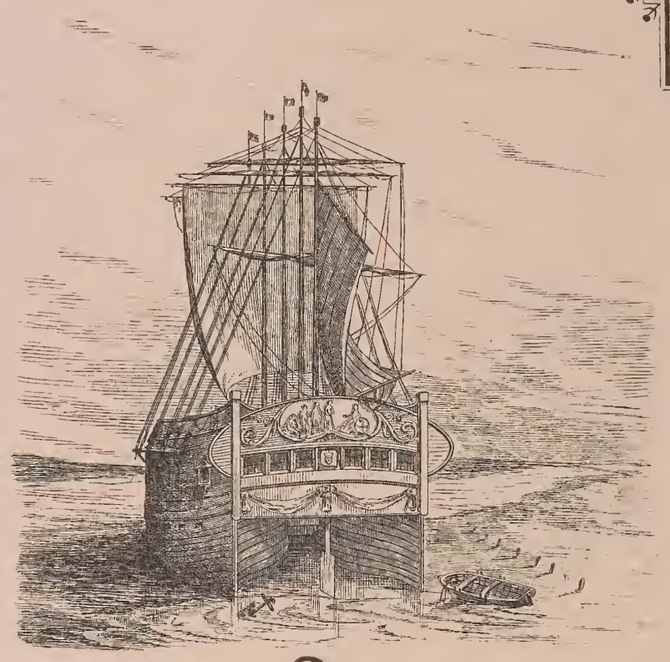
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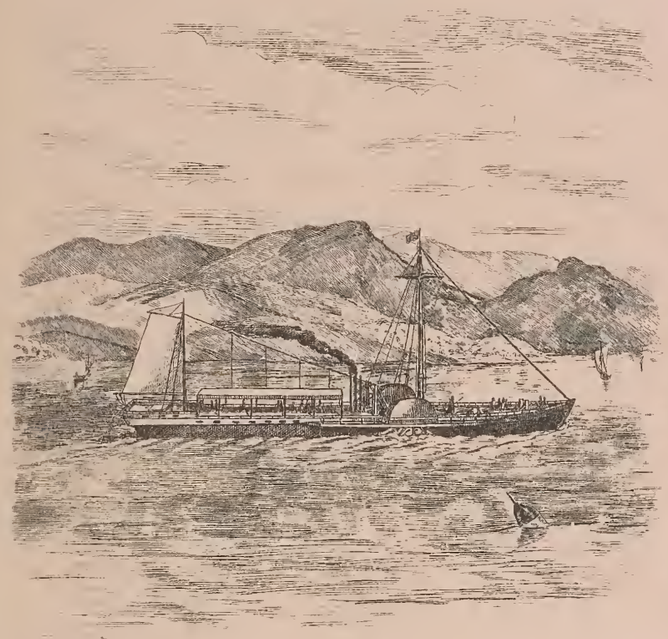
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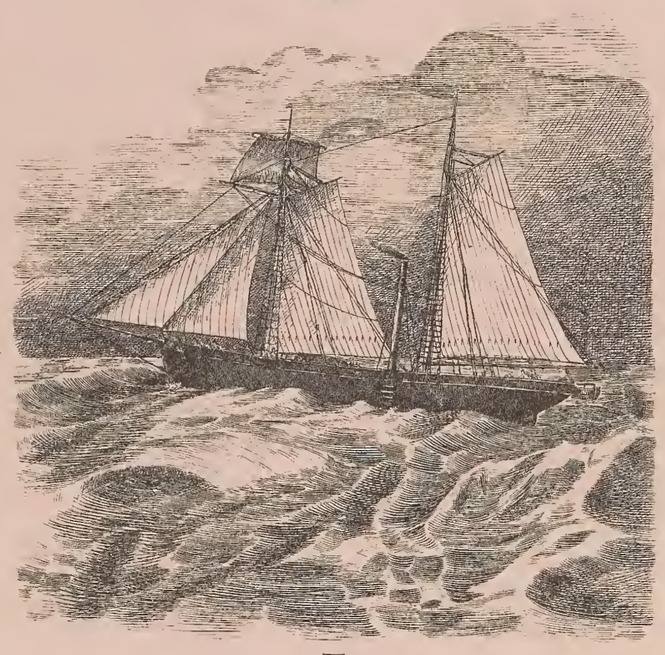
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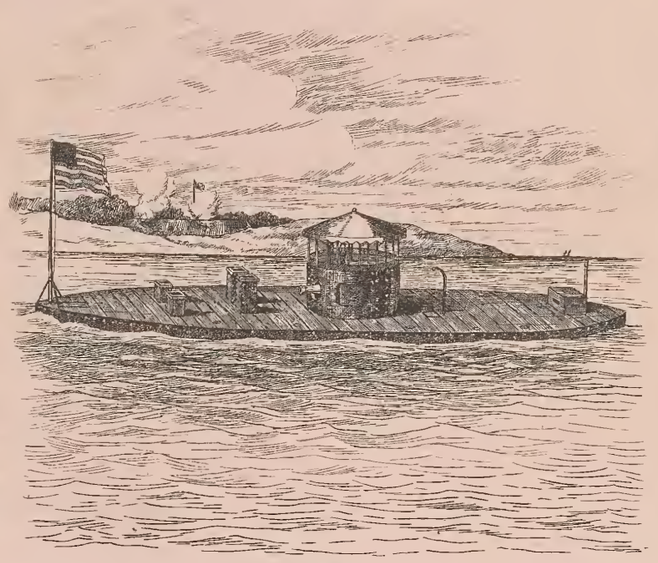
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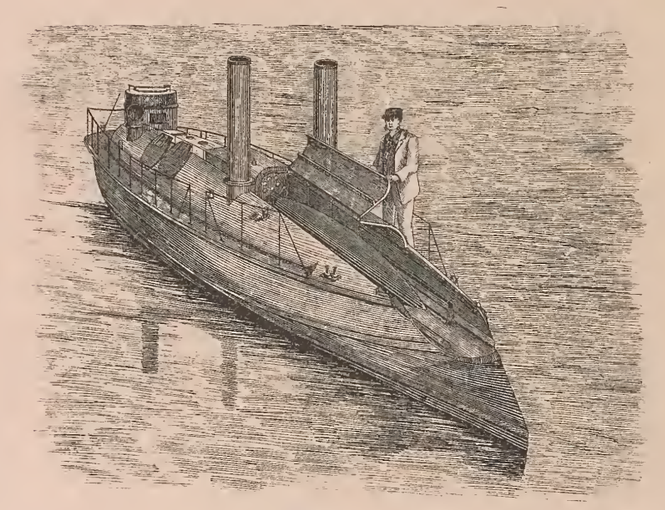
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MARINE PROPULSION.

MARINE PROPULSION.

No. 1. Primitive Indian Canoe.
2. Galley, 15th Century.
3. Double Ship—A. D. 1787.
4. Steamboat, "Clermont"—A. D. 1807.
5. U. S. Patent, Screw Steamship, "R. F. Stockton"—A. D. 1839.
6. " " Cigar Ship—A. D. 1858.
7. " " Screw Man of War—A. D. 1860.
8. " " Monitor—A. D. 1861.
9. " " Torpedo Boat—A. D. 1884.

The first use of paddle wheels may have been the velocimeters of the Ancients, in which an axis crossed the vessel, projecting over each side, and had paddle wheels four feet in diameter, which dipped into the water and were rotated by the progress of the vessel.

The boats by which the Roman army was transported to Sicily were propelled by wheels moved by oxen.

Thomas Savery, of England, obtained a patent in 1696 for a paddle wheel on each side of a vessel, to be turned by means of a capstan.

The hydraulic propeller was invented by Dr. Allen, in 1730. This method was to form a tunnel or pipe, open at the stern of the vessel, and by means of a pump to force water.

Oliver Evans, of Philadelphia, had a stern-wheel boat, which navigated the Schuylkill River in 1789.

Robert Fulton, in 1796, had a steamboat on Collect Pond, New York City, propelled by a screw astern.

The credit of the first application of the screw propeller for marine propulsion is due John Stevens, of Hoboken, N. Y., who, in 1804, constructed a boat with twin screws, which attained a very considerable speed.

Fulton successfully started his steamboat, the Clermont, on her trial trip to Albany from New York City in 1807.

Fulton's boat had side paddle wheels, as also had the Savannah, 1819, and Enterprise, 1838.

The steamboat Great Britain, 1843, had a screw, and from this date the screw propeller became common.

The Nautilus, furnished with the "Ruthven Hydraulic Propeller," had a trial trip on the River Thames in the summer of 1868. She ran at an average speed of 10.35 miles per hour.

The estimated thrust of screw propellers, with engines of one thousand horsepower, is twenty thousand pounds.

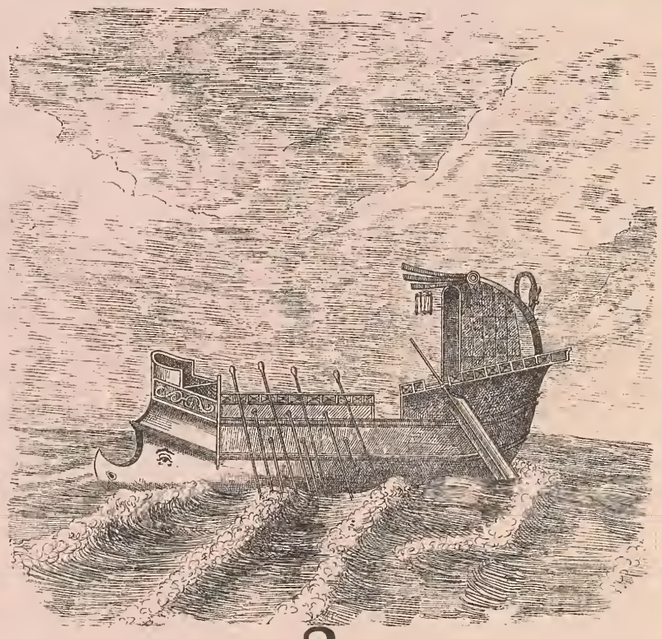
MARINE PROPULSION.

1035 Patents Granted by the United States.

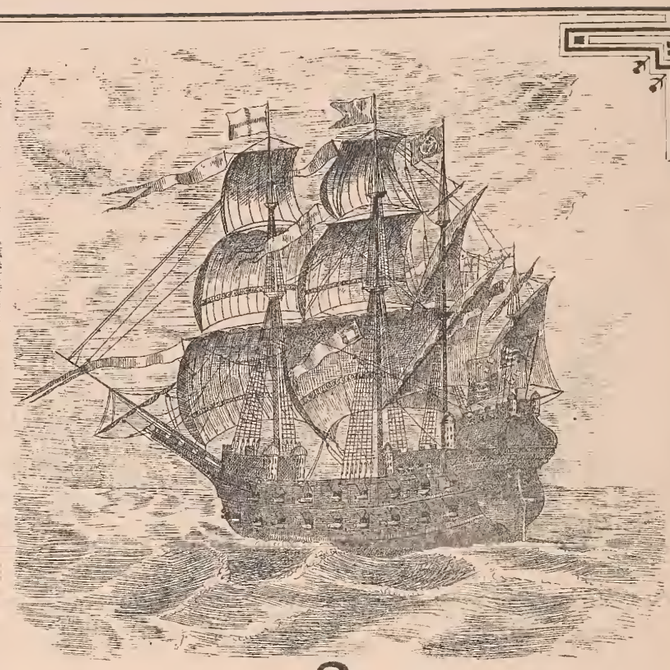
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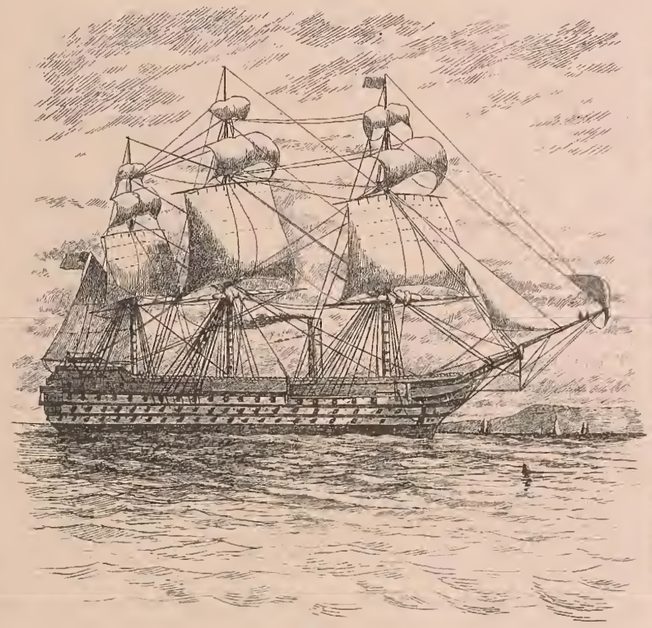
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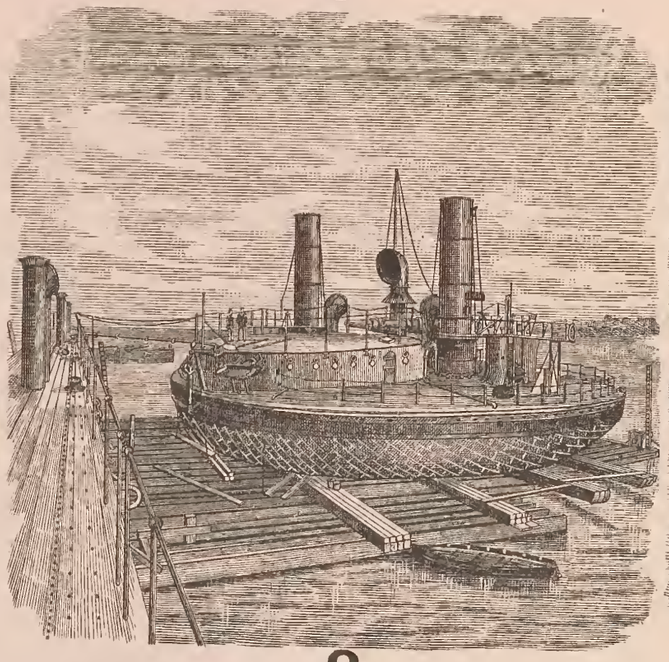
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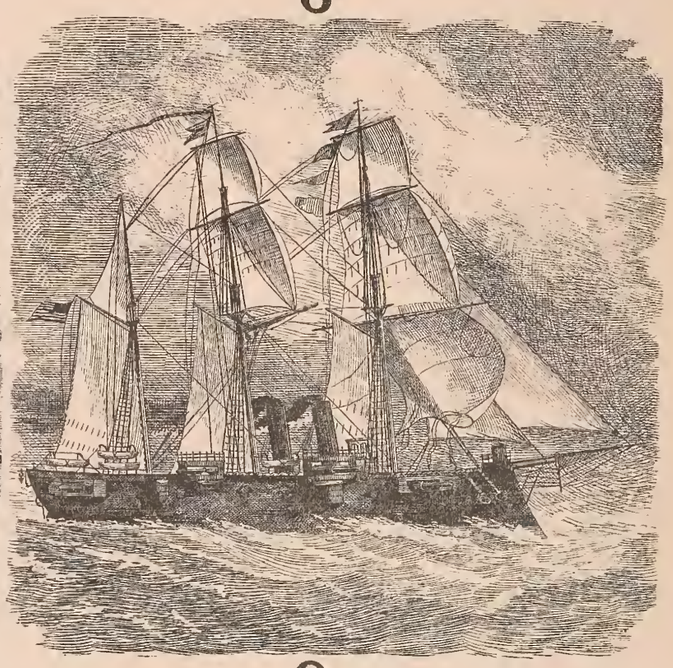
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SHIP AND BOAT BUILDING.

SHIP AND BOAT BUILDING.

No. 1. Primitive Boat Building.
2. Ancient Galley.
3. Galleon—A. D. 1571
4. "Royal Sovereign"—A. D. 1657.
5. Life Preserving Car.
6. Spar Torpedo Boat.
7. Life Boat and Carriage.
8. Circular Iron Clad.
9. War Steamer.

The first form of boat seems to have been a log, which was burnt out and then finished with pointed stones. This was succeeded by the raft, and, later, by the canoe. The sea-going qualities of the canoe seem almost incredible, voyages of hundreds of miles being made in them in tempestuous weather.

The ships on Egyptian tombs are galleys propelled by oars.

The Phœnicians attained great skill in constructing vessels.

The boats which came to Babylon, down the Euphrates, were made of skins.

Ships are often mentioned in the Bible. Balaam prophesied more than 1,000 years before it occurred, that Assyria should be destroyed by people who should come in ships from Chittim.

Sesostris built a ship 478 feet long. The Genoese are said to have first built ships to be propelled by sails alone.

Many vessels were employed as early as 1344.

The "Syracuse," a ship whose construction was superintended by Archimedes, had 20 tiers of oars, 3 decks, and required a crew of 600 men. It had sumptuous apartments, gardens, arbors, floors paved, libraries and baths, and was adorned with pictures and statues. It was presented by Hiero to Ptolemy, King of Egypt.

Henry VII. in 1500, constructed the first ship of the English Royal Navy.

Henry VIII. in 1515, had a vessel built for the navy of 1,000 tons.

During the reign of Elizabeth great progress was made by the English in ship building.

During the eighteenth century they attained great superiority in the size and shape of their vessels.

The first vessel built by Europeans in America, was a Dutch yacht, at Manhattan River, in 1614.

The first regular naval combat, in which any American vessel is known to have been engaged, occurred in 1645, between a ship built at Cambridge, Mass., and an Irish man of war, with 70 men and 20 pieces of ordnance. The New England ship had but 30 men and 14 pieces.

In 1745 the New England colonies owned, exclusive of fishing craft, about 1,000 sail of vessels. The entire amount of tonnage entered in the several colonies during the year ending January 5, 1771, was 331,642. One hundred and eighty-two vessels were built in 1772.

It is a singular circumstance that no attempt was made to construct a life boat until the year 1789, when, owing to a calamitous shipwreck on the Hind Sand, in Tynemouth Haven, England, the gentry of South Shields formed themselves into a committee and offered premiums for the best plan of a boat to overcome the dangers of a heavy, broken sea. Various plans were submitted, and preference was given to the invention of Mr. Greathead. A boat, built according to his plan, was launched on January 30, 1790, and so well did it answer that hundreds of lives have been saved by it, and in no instance did it fail.

The steamboat built by John Fitch, propelled by 12 oars, made her first trip June 5, 1790, on the Delaware river, between Philadelphia and Trenton, thus accomplishing the most successful experiment in steam navigation made in Europe or America.

The first American vessel on Lake Erie was constructed in 1797. In 1807, the "Clermont," built by Fulton and Livingston, which had been launched in the spring of this year, was completed. She was supplied with a steam engine built by Watt and Britton, of England, and made her first trip to Albany, New York, in 32 hours.

American ship builders early abandoned the European models, and constructed the finest frigates, sloops and coasting schooners.

American clippers became famous. One of these vessels made the voyage from the Sandwich Islands to New York, a distance of 17,597 miles, in 82 days. Iron was experimentally used for ships in 1821, and came into permanent use about 1830.

The marked improvements of modern times are the increased length of the vessel, and the substitution of a concave instead of a convex form from the stern back on each side of the ship.

From observations made by Mr. Scott Russell, in 1832, upon the shape of a wave, he designed the hollow lines drawn from the stem.

The Francis metallic life boat was invented in 1838, and patented in the United States in 1845. The most important part of the construction consisted in the longitudinal corrugations formed in the sheet metal, by which the strength and stiffness were much increased.

The Francis life car resembles a boat, being a water tight metallic shell, with a hatchway or cover, and adapted to travel on ropes whose ends are connected to the ship and to the shore respectively. The passengers are inclosed in the car, and the stops are made by hauling on a rope attached to the car, and grasped by parties on board and ashore.

One of Francis' cars was the means of saving two hundred lives from the ship "Ayrshire," which went ashore at Long Branch, New Jersey, in January, 1850.

The lines of the "Great Eastern" were designed by Mr. Russell, in accordance with his theory of wave lines. Elm is principally used in England for the keel of vessels, but live oak is preferred in the United States.

In recent years boats made of corrugated sheet metal have come into use. Paper boats are made by fitting successive sheets over a model of the exact form, with varnish between the layers.

The use of steel for constructing vessels has recently been introduced.

SHIP AND BOAT BUILDING.

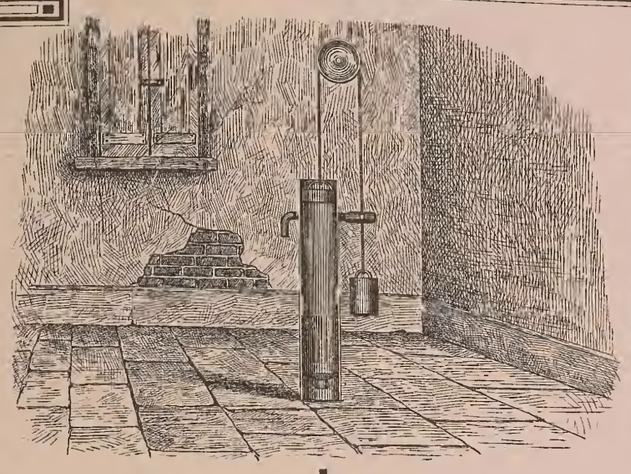
2,188 Ship and Boat Building Establishments in the United States.

	1860	1880
Capital Invested,	$5,472,815.00	$20,979,874.00
Value of Productions,	11,667,661.00	36,800,327.00
Wages Paid,	4,154,509.00	12,713,813.00
Hands Employed,	9,260	21,345

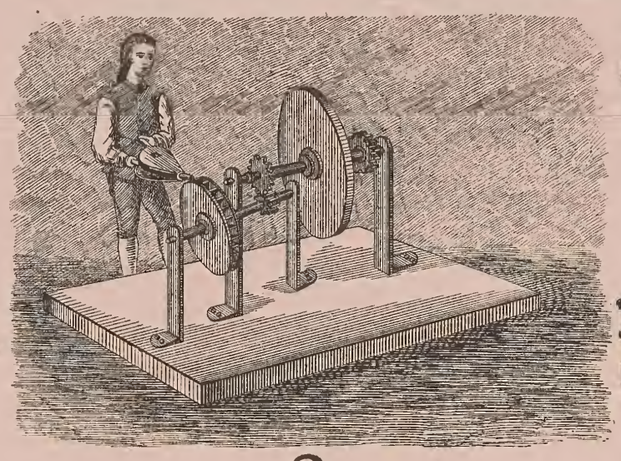
	1880
New Vessels built,	2,415
Boats built,	8,026
Vessels repaired,	16,507

2,492 Patents Granted by the United States.

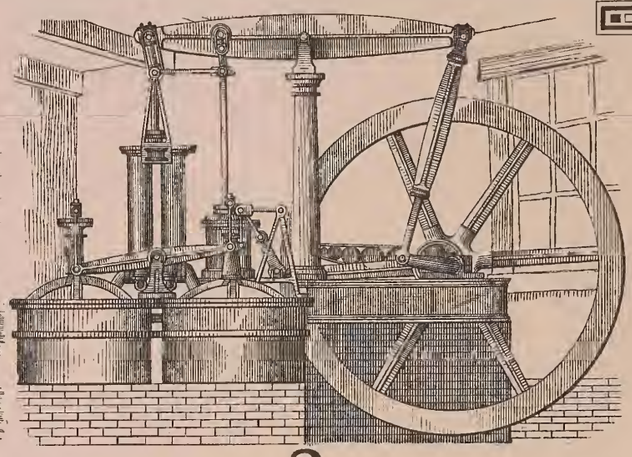
Sackett & Wilhelms Litho Co New York



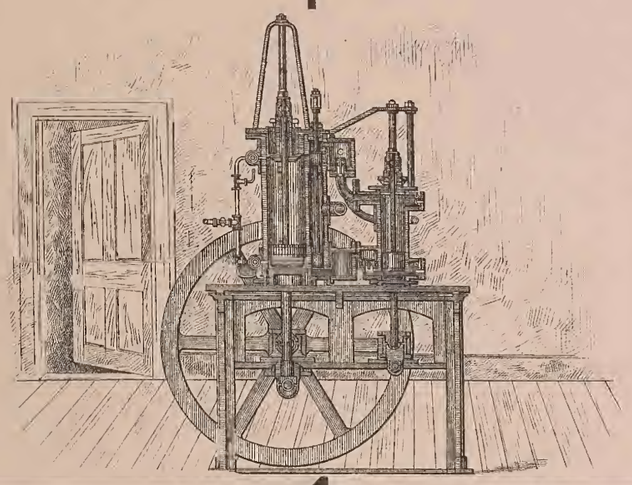
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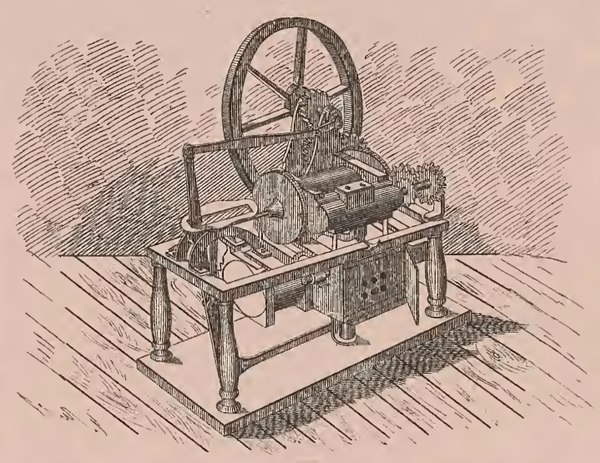
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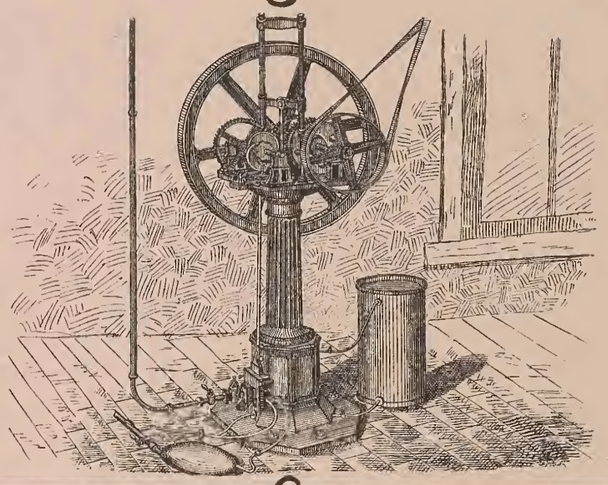
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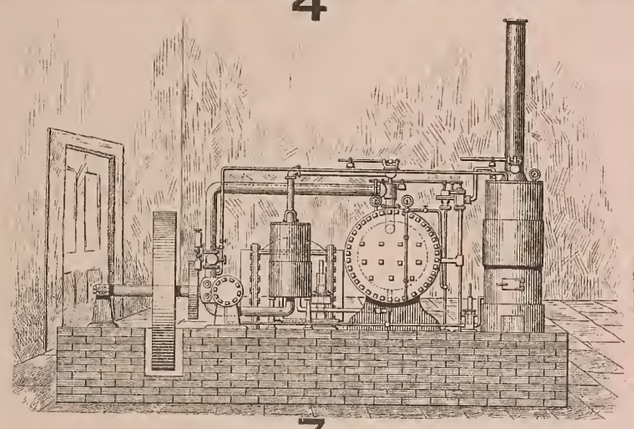
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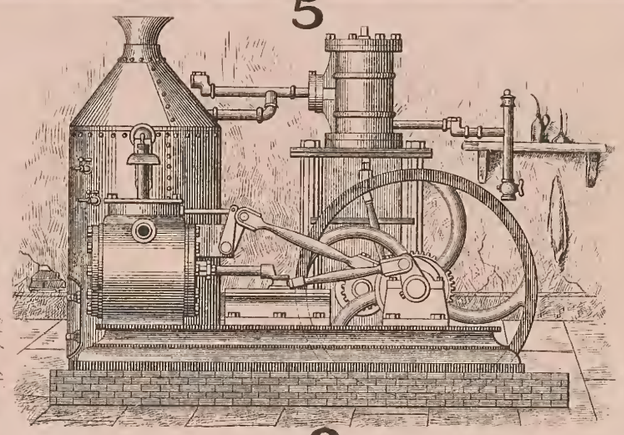
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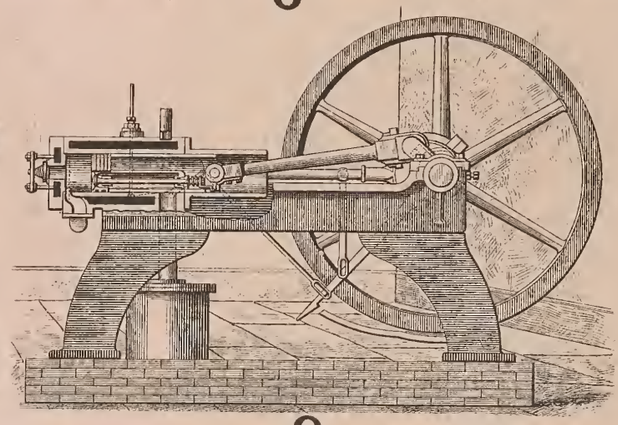
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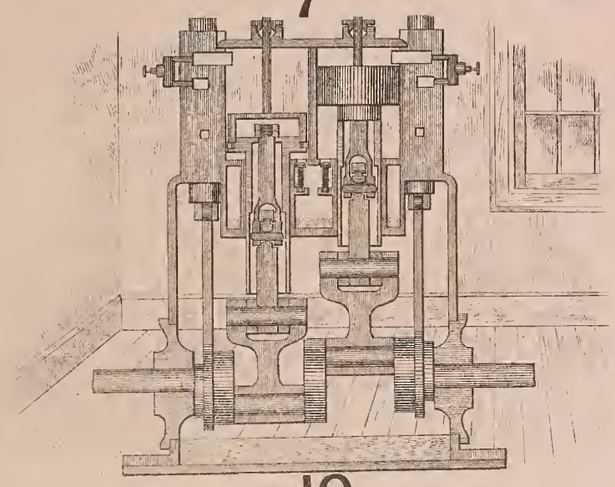
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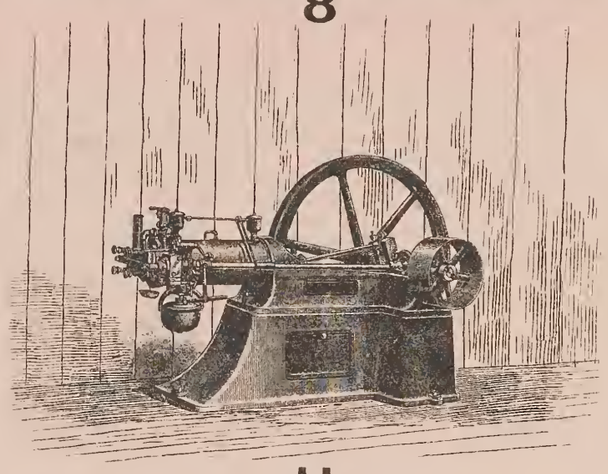
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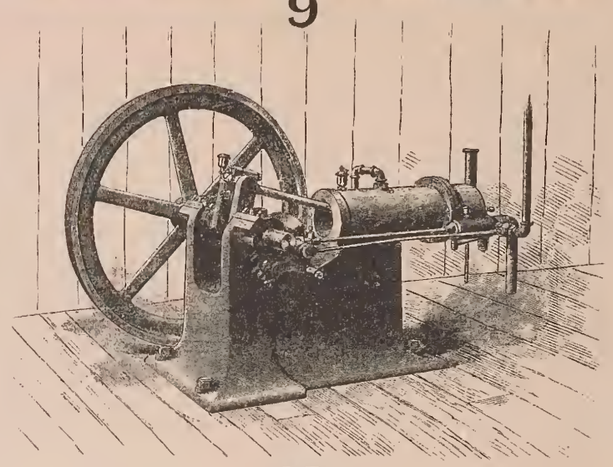
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12

AIR AND GAS ENGINES.

For more than a century the attention of mechanicians has been directed to means for making air and gas available in driving machinery.

Amonton, France, in 1699, had an atmospheric fire-wheel, or air engine, in which a heated column of air was made to drive a wheel. Some have attempted to make available the expansion of air, previously mechanically condensed and stored in reservoirs. It was not understood, apparently, that the valuable effect would only be equal to the force employed in condensing the air, minus friction, leakage and other incidentals. This form settled down to two classes of machines—

1st. Those which were locomotives, as in Bouepas's air-driven carriage, patented in 1828, where the air was condensed in tanks and admitted to the alternate ends of a cylinder, which had a reciprocating piston, connected in the usual manner to the crank and drive-shaft. Von Rathen used the same device in 1848, at Putney, England, where he ran an air locomotive at the rate of ten or twelve miles an hour.

2d. Those in which a body of air is condensed into a reservoir, placed at the bottom of a shaft, or in a situation where the prime motor cannot be set up. In this case the engine in the mine is run by the air from the reservoir during a lull in the force of the prime motor.

Medhurst secured patent on this in England, in 1799. He condensed air to one-fifteenth of its volume, and stored it for this purpose. Fisk's U. S. patent air reservoir in 1865 had a similar purpose.

Another form of air engine has two chambers filled with air or gas, connected by pipes with the respective ends of a cylinder, in which a piston reciprocates as the bodies of air in the cylinders are alternately expanded and contracted. Sterling's English patent, 1827, was of this character, and is stated by Chambers "to have been unsuccessful, owing to mechanical defects, and to the unforseen accumulation of heat not fully extracted by the sieves or small passages in the cool part of the regenerator, of which the external surface was not sufficiently large to throw off the uncovered heat when the engine was working with highly compressed air."

Sterling is said to have been the originator, in 1816, of the regenerator wherein the heat of the exhausting air is made to heat surfaces which communicate heat to the incoming air for the next charge. The same idea was found in the English patent of Glazebrook, in 1797.

Sterling made improvements in 1840, which he also patented. In this engine two strong, air-tight vessels are connected with opposite ends of a cylinder, in which a piston works in the usual manner; four-fifths of the interior space in these vessels are occupied by two similar air vessels, or plungers, suspended to the opposite extremities of a beam, and capable of being alternately moved up and down to the extent of the remaining fifth. By the motion of these interior vessels the air to be operated upon is moved from one end of the exterior vessel to the other, and as one end is kept at a high temperature, and the other as cold as possible, when the air is brought to the hot end it becomes heated and has its pressure increased, whereas its heat and pressure are diminished when it is forced to the cold end. Now, as the interior vessels move in opposite directions, it follows that the pressure of the enclosed air in the one vessel is increased, while that of the other is diminished; a difference of pressure is produced on opposite sides of the piston which is made to move from one end of the cylinder to the other; the piston is connected with a fly-wheel, and motion communicated in the usual way. In this engine the air received heat at the temperature of 650° Fah. and discharged the last heat at 150° Fah. The efficiency of a perfect engine with those limits of temperature would be 0.45 and its consumption of coal 0.73 of a pound per horse power per hour. The actual consumption of coal per horse power per hour was about two and two-tenths pounds, being three times the consumption of a theoretically perfect engine, and corresponding to an actual efficiency of 0.15, or one-third of the maximum theoretical efficiency.

Sterling's air engine was more economical than the double-action steam engine.

A third form of the apparatus embraces but few features. These have been modified by independent inventors to such an extent that they now represent more than eighty patents. Glazebrook seems to have fully anticipated the usefulness and the future of the air engine. His second patent in 1801 has a refrigerator whose use is not to cool the pump wherein the air is condensed, but to deprive the escaping gas of its heat, in case a gas be used of so expansive a character as to preclude its being ejected into the atmosphere after using. He cites carbonic acid and other gases and compounds. He only antedated the engine of Brunel by three years, which was intended to be used without the escape of carbonic acid.

Lillie's air engine, patented in 1819, is in the same line of invention: the air is compressed by mechanical force, passed through heated tubes, expanded against a piston and there escapes into the open air. Air engines are used extensively for driving light machinery, and are very desirable where water is scarce.

The claim for the Ericsson engine was that he intended to use the same portion of heat in producing mechanical power, over and over again, by the means of a regenerator. The regenerator was used by Sterling in 1816, and Glazebrook in 1797, in air engines.

The principle on which the Ericsson regenerator rests is the repeated use of the same caloric. In 1852 a ship was built, one thousand tons burden, two hundred and fifty feet long, with paddle wheels thirty-two feet in diameter, to be propelled by air. On January 4th, 1853, the ship on her trial trip made twelve knots an hour, with the wind, using only six tons of fuel per day.

On the second trial the greatest speed attained was nine knots. The ship, named after the inventor, failed to establish the validity of the principle involved. He took out another patent in 1855 for certain novelties in the apparatus. Ericsson patented improvements in air engines in 1851, 1855, 1856, 1858 and 1860.

The first gas engines were gunpowder engines; the gas generated by the explosion being the means of expelling the air, the condensation of the gases producing a partial vacuum in the chamber.

D. Hautefeuille, in 1678, first used this power.

Hughens applied it in a cylinder so that the atmospheric pressure might force a piston downward when the vacuum was thus formed beneath it. In 1791 Barber obtained an English patent for a gas engine, in which a stream of carbureted hydrogen gas was introduced at one induction port and a quantity of atmospheric air at the other, the resulting combustion giving an explosive force against the pistou.

Street, in 1794, proposed to use the expansive power of heated gas instead of its explosive power. Lebon's French patent of 1799 described the distillation of carbureted hydrogen from coal, and its introduction into the cylinder beneath the piston, and, simultaneously at another channel, a proper proportion of atmospheric air. The mixed gases were exploded by the electric spark, their dilation furnishing the desired motive power.

Brunel's gas engine, in 1825, consisted of five distinct cylindrical vessels. Davy and Faraday, in 1823, succeeded in reducing several gases to a liquid state by means of great pressure and very low temperature. This discovery again turned attention to gas engines. Cooper, in 1835, described an engine in which one part oxygen and two parts hydrogen were ignited to produce a vacuum alternately on each side of a piston. Johnson's patent of 1841, proposed to introduce pure hydrogen gas and oxygen, instead of atmospheric air.

The Otto and Langens gas engine is an upright hollow column having a heavy piston, whose rod is a rack acting upon cog-wheels on the fly-wheel shaft; as the piston ascends the cog-wheel slips loosely on the shaft, and the mixed gases, coal gas and air are exploded by communication with the gas jet, which is kept constantly burning.

As the gases rapidly condense after explosion the atmospheric pressure, aided by the weight of the piston, is made effective upon the shaft of the wheel by the engagement of the rack teeth with those of the spur wheel.

In Lenoir's gas engine, now much employed in France, the source of power is the expansion arising from the explosion of gas. Air and gas are admitted to a cylinder in the proportion of 11 to 1; a spark from a galvanic battery is sent through it; the spark explodes the mixture, and the expansion consequent on this explosion drives a piston to the other end of the cylinder. Mechanism does all the rest; opens a slide valve to permit exit to the exploded mixture, drives the piston back by the momentum of a fly-wheel, opens tubes for the admission of new air and gas, establishes connection again with the battery, and prepares for a renewal of the action, and so on continuously. These engines are costly in the first instance, and many precautions are necessary to prevent them being overheated; but they require no fireman, and are rather cheaper to work than steam engines; consequently they are much employed for two to four-horse power purposes.

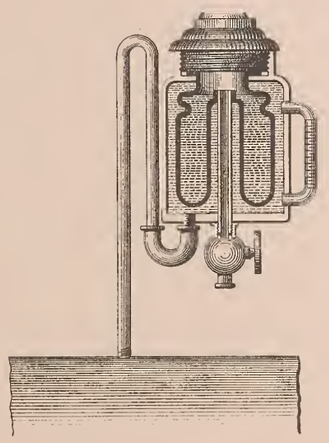
AIR AND GAS ENGINES.

No. 1. Gunpowder Engine—A. D. 1680.
2. Primitive Air Engine—A. D. 1794.
3. U. S. Patent, Hot Air Engine—A. D. 1827.
4. " " Explosive Gas Engine—A. D. 1838.
5. " " " " " —A. D. 1844.
6. " " " " " —A. D. 1867.
7. " " Bi-sulphide of Carbon Engine—A. D. 1882.
8. " " Steam and Hot Air Engine—A. D. 1883.
9. " " Explosive Gas Engine—A. D. 1883.
10. " " " " " —A. D. 1883.
11. " " " " " —A. D. 1883.
12. " " " " " —A. D. 1884.

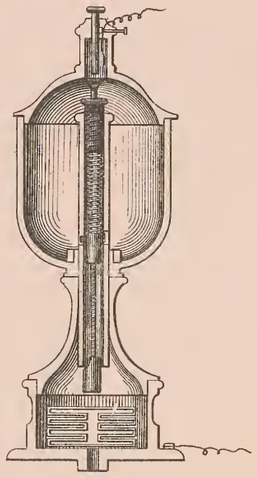
AIR AND GAS ENGINES.

403 Patents Granted by the United States.

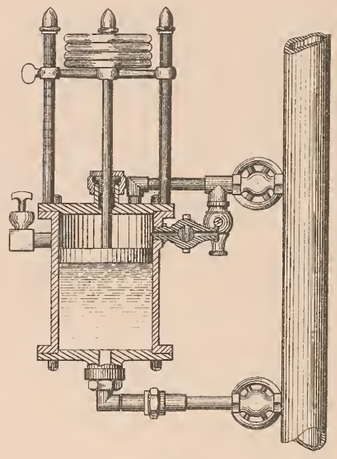
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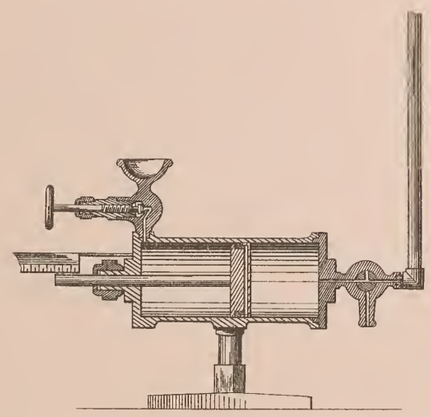
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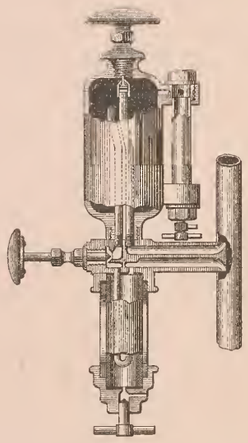
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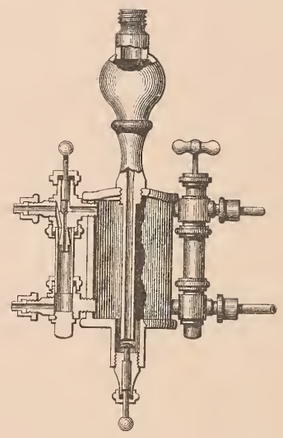
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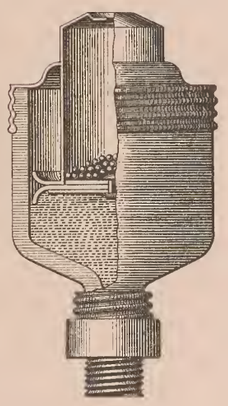
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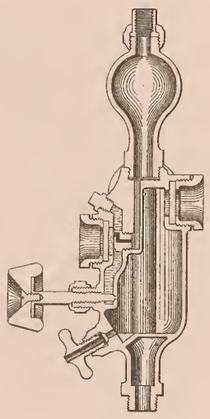
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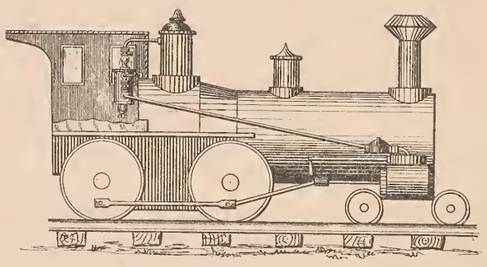
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LUBRICATORS.

LUBRICATORS.

No. 1. U. S. Patent, Lubricator—A. D. 1851.
2. " " Thernoscopic Lubricator—A. D. 1876.
3. " " Steam Engine Lubricator—A. D. 1878.
4. " " Hydrostatic Pressure Lubricator—A. D. 1879.
5. " " Lubricator—A. D. 1881.
6. " " " —A. D. 1882.
7. " " Glass Cup Lubricator—A. D. 1883.
8. " " Steam Engine Lubricator—A. D. 1884.
9. " " Locomotive Lubricator—A. D. 1884.

An early form of oiler is to be seen in the British Museum. It is a small horn with a plate on the end, and a nozzle through which the oil exuded. It was found at Thebes.

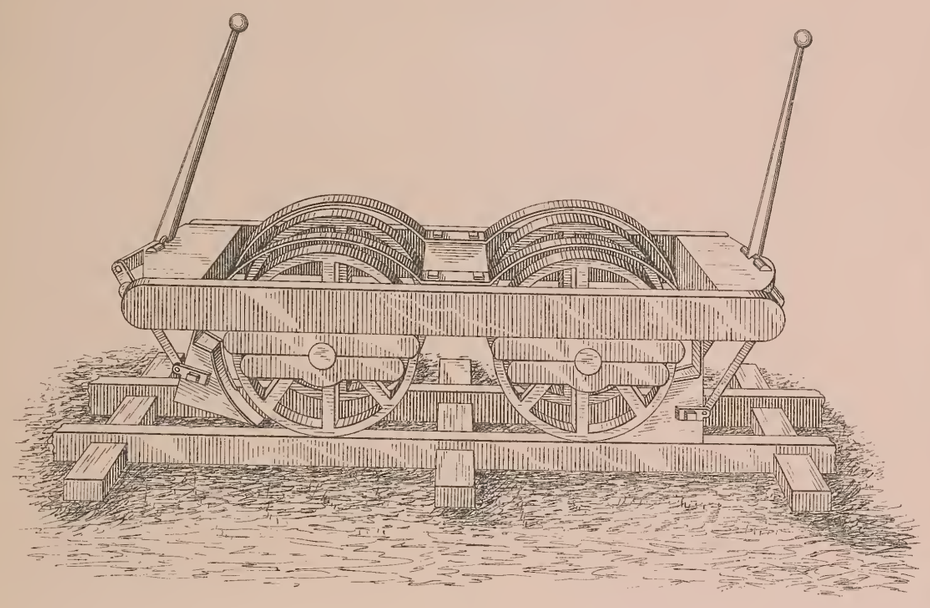
According to a correspondent of the "Railroad Gazette," the Erie Railroad has reduced its oiling expenses from $5,000 to $1,000 a year, by using paraffine on passenger car journals, and has reduced the number of hot journals from 535 to 332.

It is stated that a step in Starr's flour mill at Vallejo, California, supporting a 4-ton shaft making 93 revolutions per minute, had been constantly running, day and night, for seven months with the hydrostatic lubricator without changing the oil; and the oil, when taken from the reservoir at the end of that time, had not become thickened or discolored in any appreciable degree.

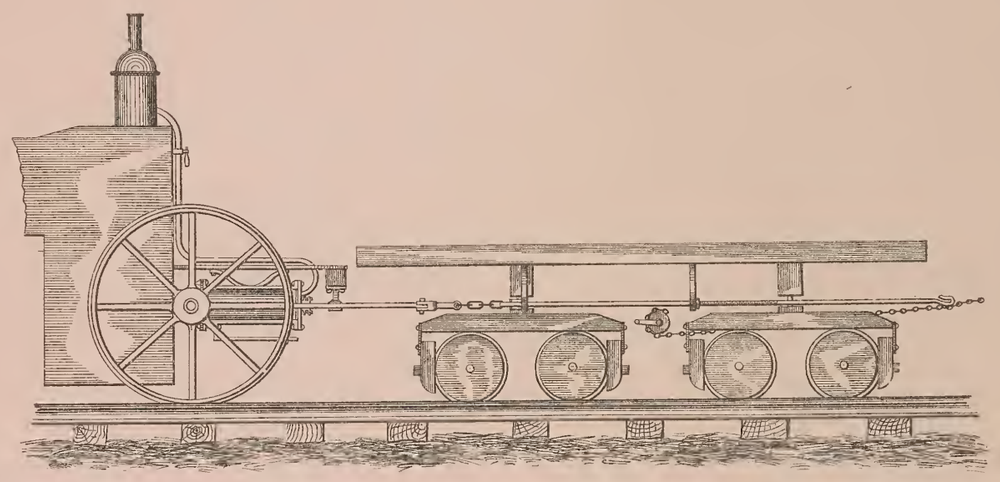
LUBRICATORS.

794 Patents Granted by the United States.

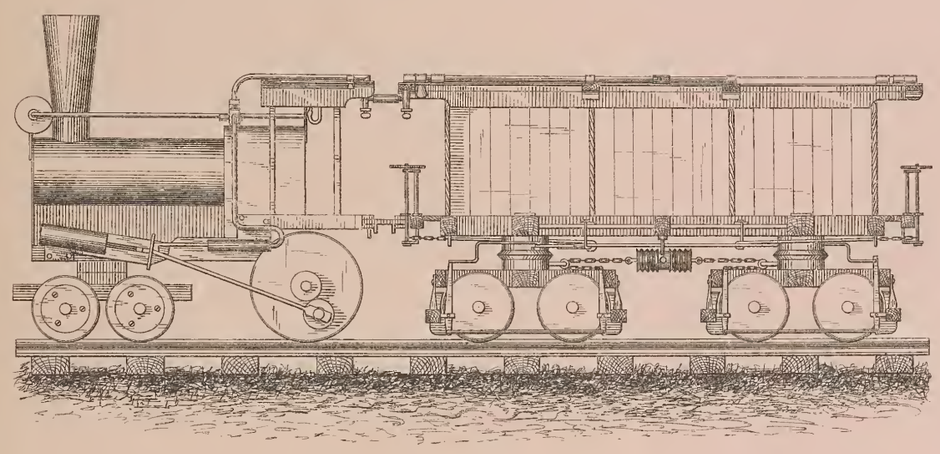
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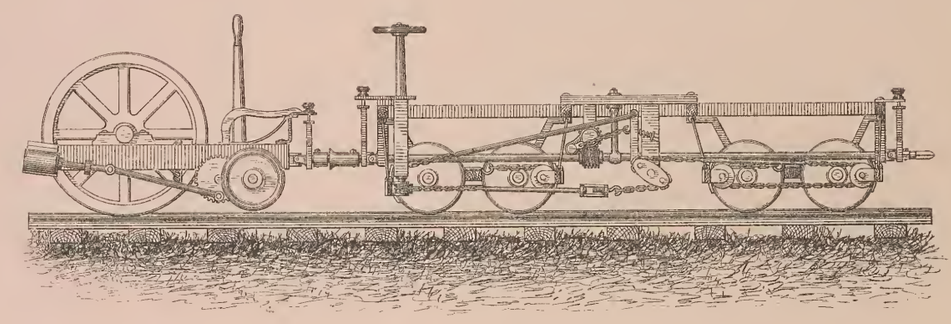
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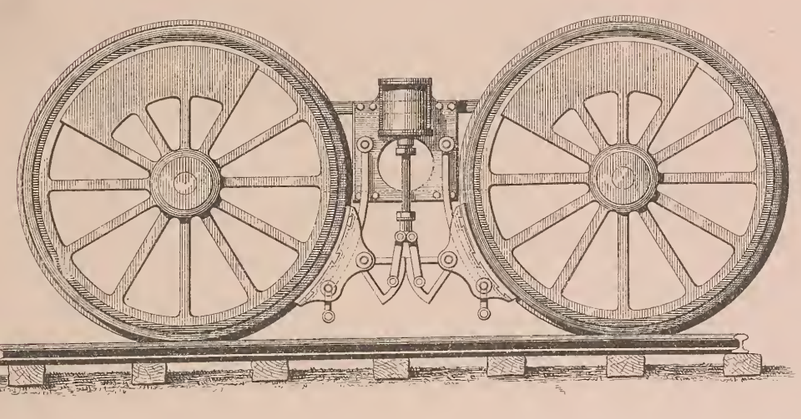
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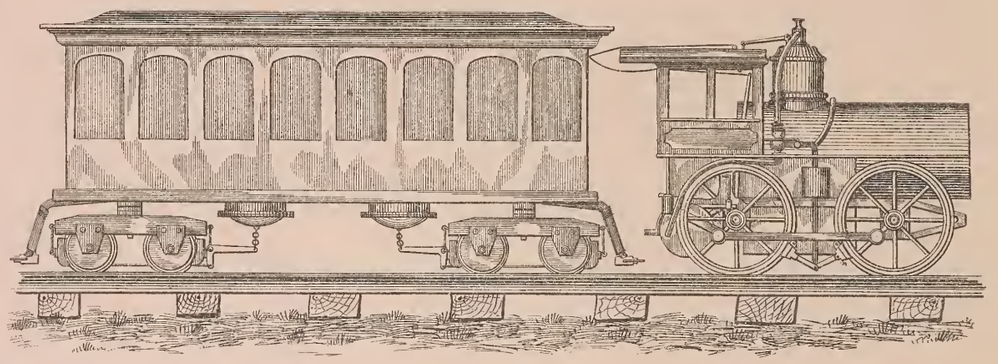
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STEAM AND AIR BRAKES.

STEAM AND AIR BRAKES.

No. 1. U. S. Patent, Hand Power—A. D. 1840.
2. " " Steam—A. D. 1858.
3. " " Air—A. D. 1860.
4. " " Steam—A. D. 1862.
5. " " Locomotive Drive Wheel—A. D. 1874.
6. " " Vacuum—A. D. 1875.

Car brakes, until the advent of the atmospheric brake, were actuated by a winding drum connecting with chains and levers, the power of the brakeman being applied to a hand-wheel on the car platform.

The Westinghouse atmospheric brake has been adopted on most of the railway lines in the United States and Europe.

Its chief features are, first, the use of compressed atmospheric air as a means of applying the brakes; and, second, putting the whole braking apparatus under the direct control of the locomotive engineer, so that he can apply the brakes at pleasure, instantaneously or gradually, and with any desired power, limited only by the power of the air-compressing apparatus and the strength of the air vessels.

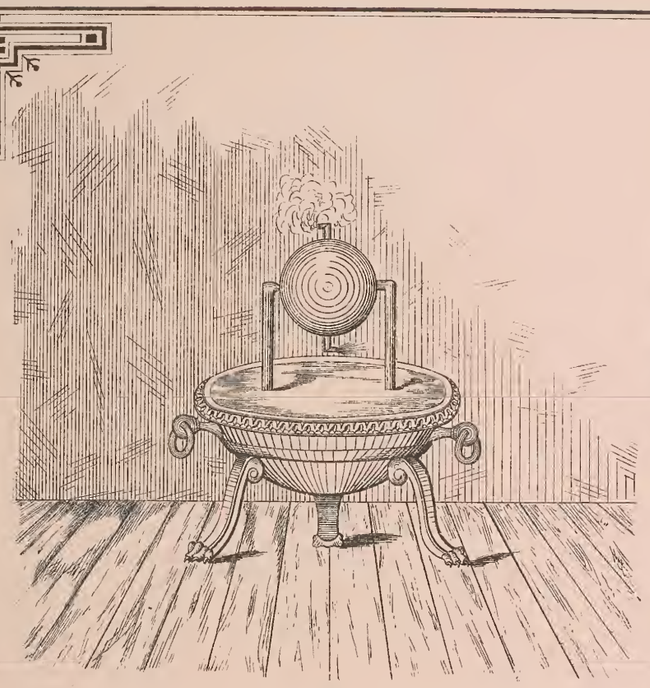
At a test of the Westinghouse air brake on the Kansas Pacific Railway May 12, 1871, a train going at the rate of 45 miles an hour was stopped within a distance of 250 feet.

At a recent test of the Westinghouse air brake, a freight train of fifty cars, 1,900 feet long, and weighing 2,000,000 pounds, drawn by a heavy engine, was brought to a standstill in 12½ seconds, and within 200 feet from the marking post, the train running at the rate of 20 miles an hour.

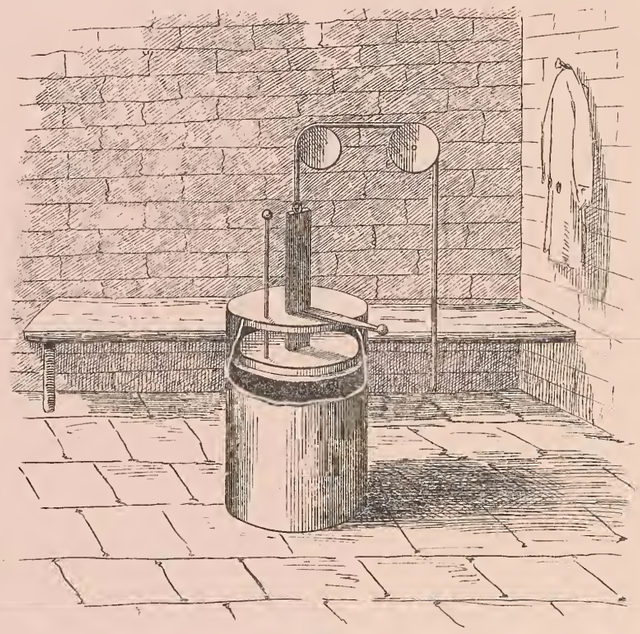
STEAM AND AIR BRAKES.

290 Patents Granted by the United States.

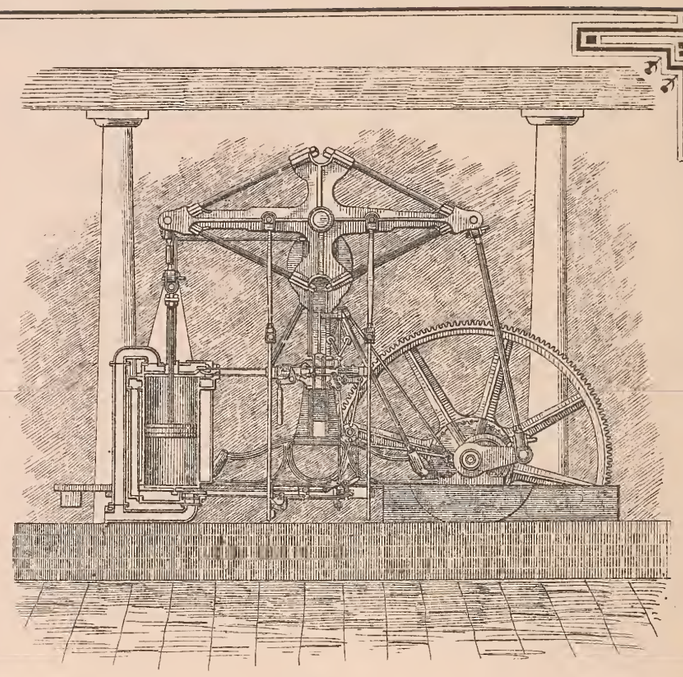
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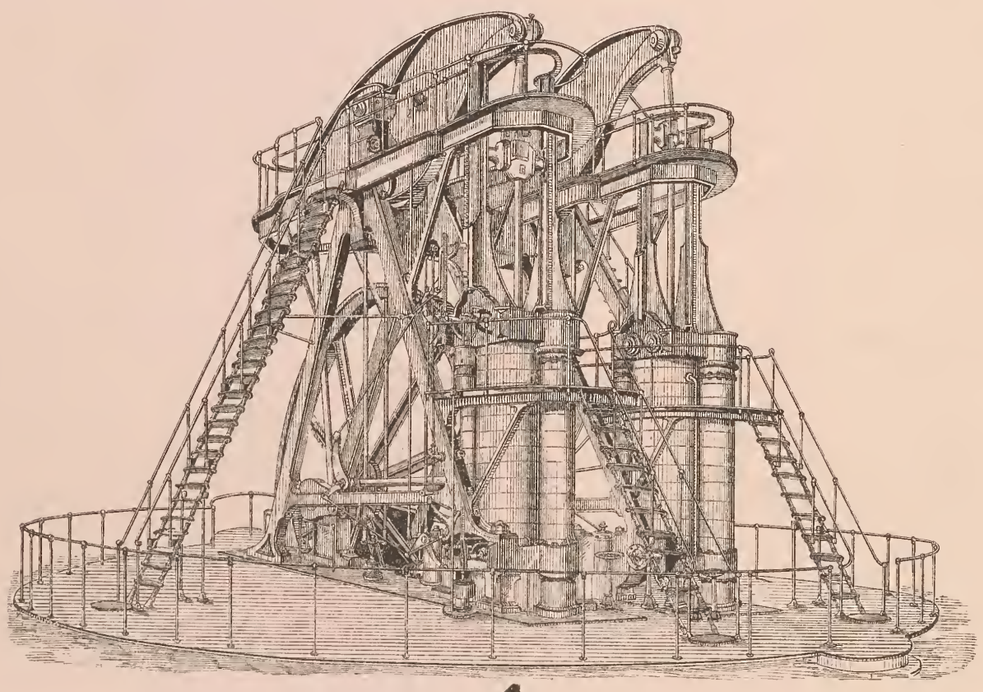
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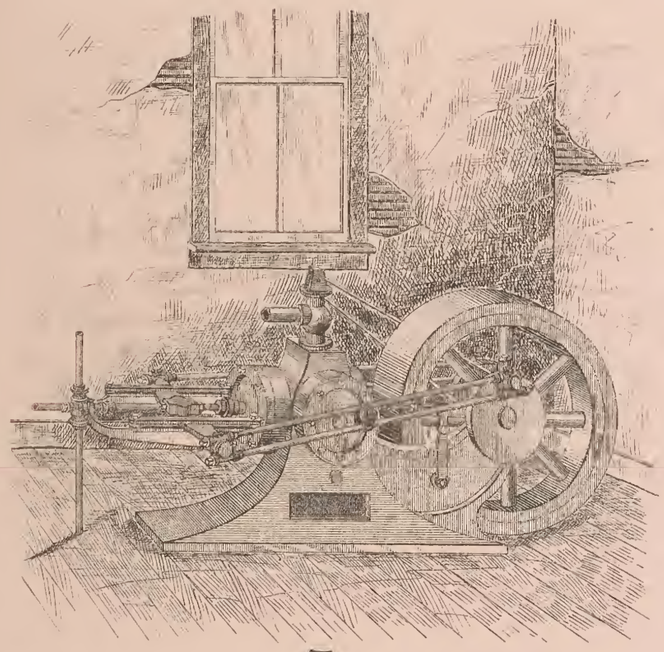
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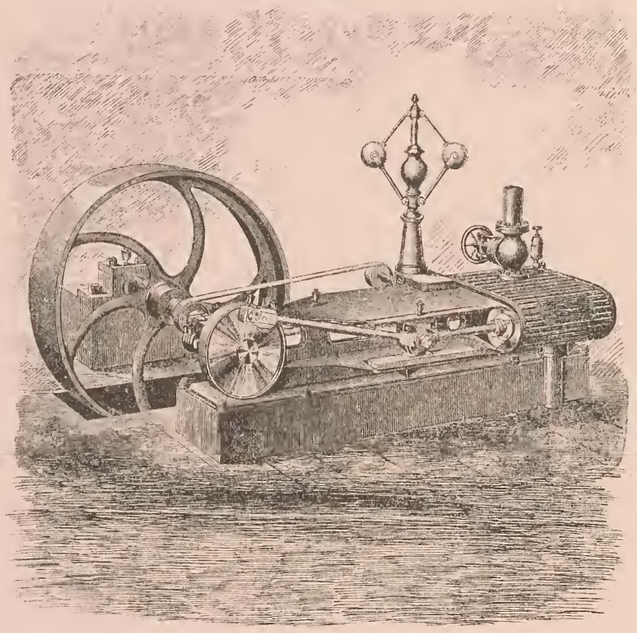
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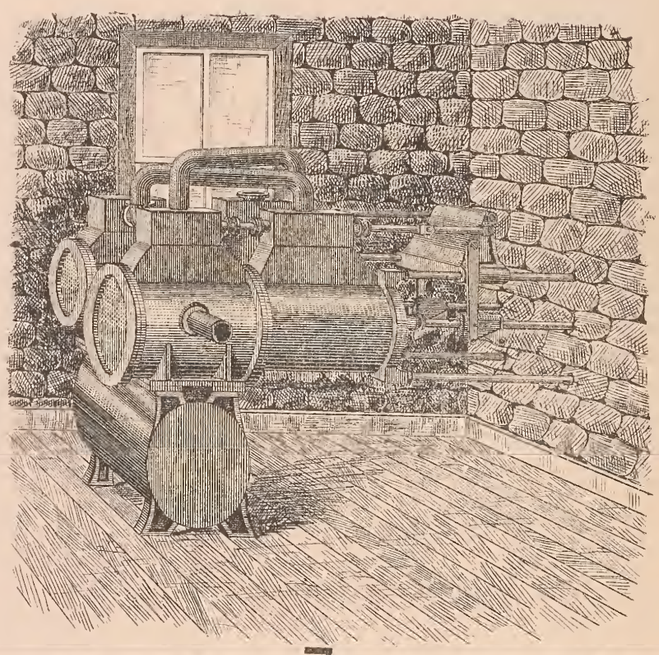
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7

STEAM ENGINES.

STEAM ENGINES.

No. 1. First Steam Engine—B. C. 200.
2. Piston Steam Engine—A. D. 1690.
3. U. S. Patent, Beam Engine—A. D. 1849.
4. " " " " —A. D. 1876.
5. " " Direct Acting Engine—A. D. 1882.
6. " " Horizontal Engine—A. D. 1883.
7. " " Duplex Engine—A. D. 1883.

Baptista Porta, in 1600, contrived an apparatus for exhibiting the power of steam.

Solomon De Caus, about 1620, wrote a book in which he claims to have invented a steam engine.

The first engine on this Continent was brought over from England in 1736; and prior to the Revolutionary war there were but two steam engines in the Colonies: one was built for use in a distillery in Philadelphia, and the other was imported, as stated above, for the Schuyler Copper Mines, in Passaic, N. J. Both were of the Newcomen type.

James Watt, of Glasgow, when repairing a model of a Newcomen engine in 1763, began a series of improvements which finally rendered the steam engine universally applicable. To avoid losses of heat in the steam cylinder, he attached in 1765 the separate condenser, thus saving three-fourths of the injection water needed in the Newcomen engine.

The first steam engine constructed in this country was built at Philadelphia, Pa. in 1779.

Oliver Evans, of Philadelphia, Pa., invented the "high pressure non-condensing steam engine."

In 1785 Mr. Evans first applied steam to the grinding of plaster and the sawing of stone, and to flour mills.

A recent writer has calculated that the engines of a first-class Atlantic steamer contain 6,000 parts, with 2,270 boiler tubes, 4,456 condenser tubes, 64,888 rivets, 10,407 nuts, 3,000 studs, 7,868 bolts, 1,582 boiler stays, 1,356 furnace bars, and 1,144 pins. In addition to these there are 100 moving parts, 271 steam pipes, 147 valves, 37 levers, 24 furnaces, and 172 pieces belonging to the pumping-out arrangements. The number of auxiliary engines would be about 23.

An idea of the extreme lightness of steam may be obtained by the statement that it takes 27.2222 cubic feet of steam at the pressure of one atmosphere to weigh one pound, avoirdupois.

Some conception of the enormous results of steam power may be gained from the fact that the aggregate steam power in use in the world is at present three and one-half millions horse-power employed in stationary engines, and ten millions horse-power in locomotive engines. This force is maintained without the consumption of animal food, except by the miners who dig the coal, and the force maintained in their muscles is to the force generated by the product of their labor about 1 to 1,080. This steam power is equal to the working force of twenty-five million of horses, and one horse consumes three times as much food as one man. The steam power, therefore, is equivalent to the saving of food for seventy-five millions of human beings.

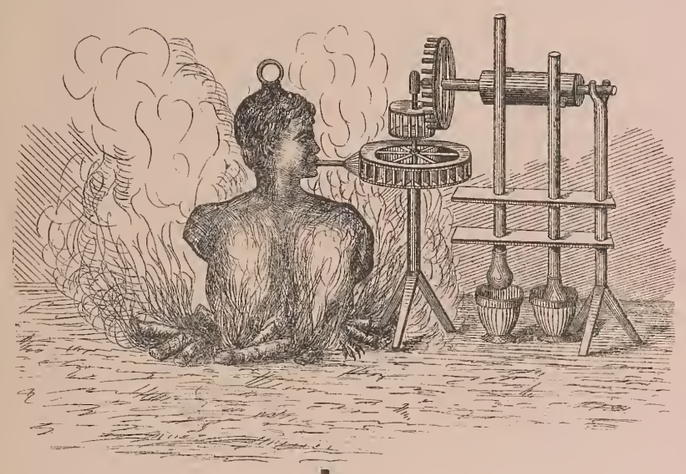
Further, three power looms attended by one man produce seventy-eight pieces of cotton fabric against four pieces produced by one hand loom worked by one man in the year 1800.

A carpenter's planing machine does the work of twenty men.

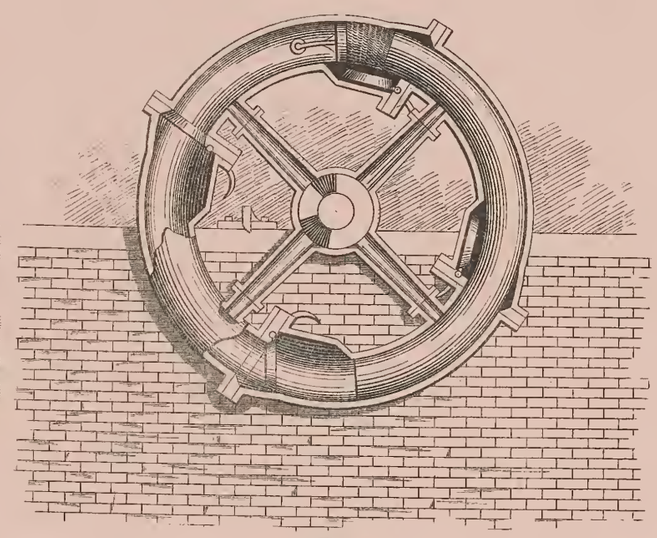
STEAM ENGINES.

4,337 Patents Granted by the United States.

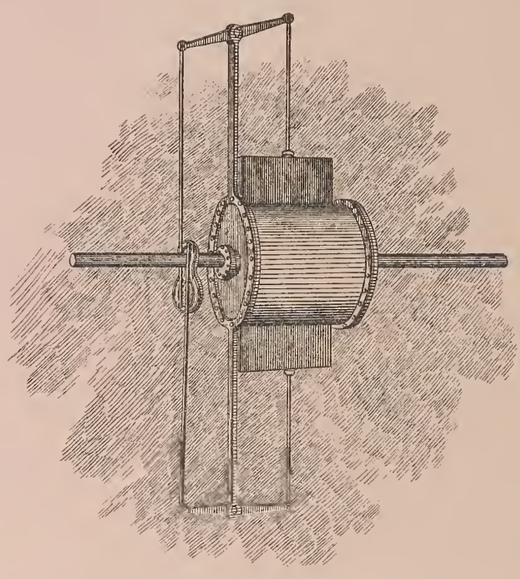
Sackett & Wilhelms Litho Co New York



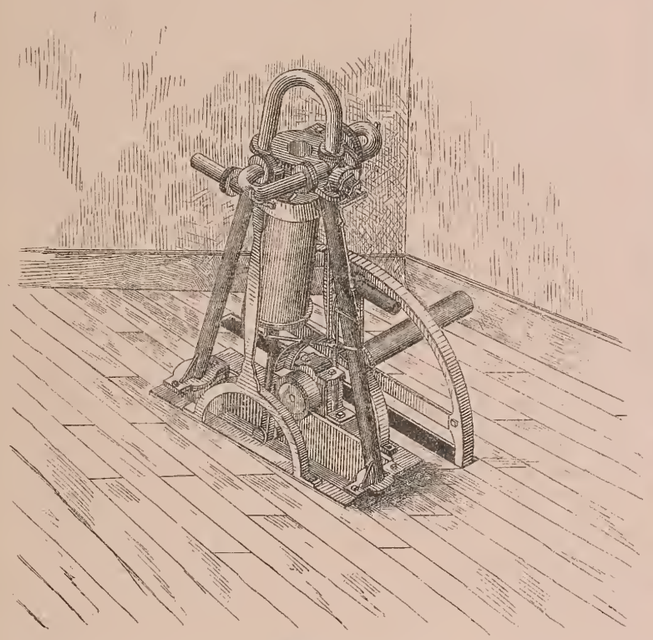
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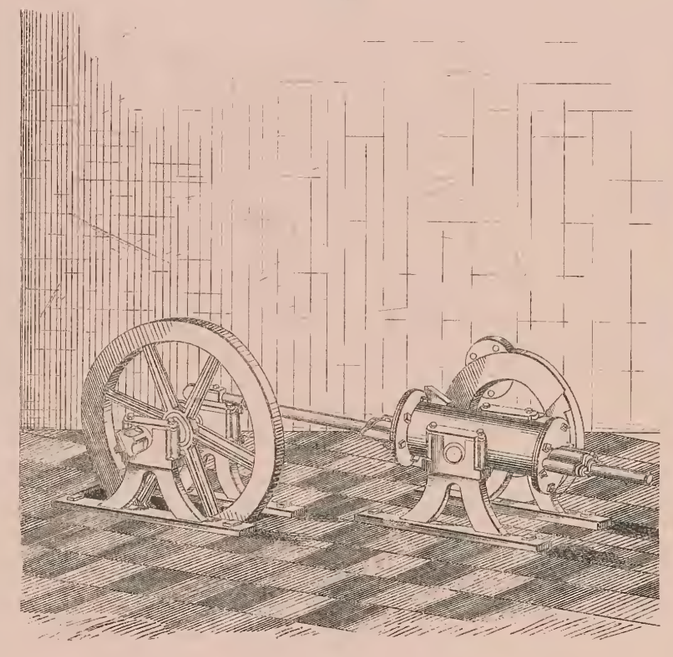
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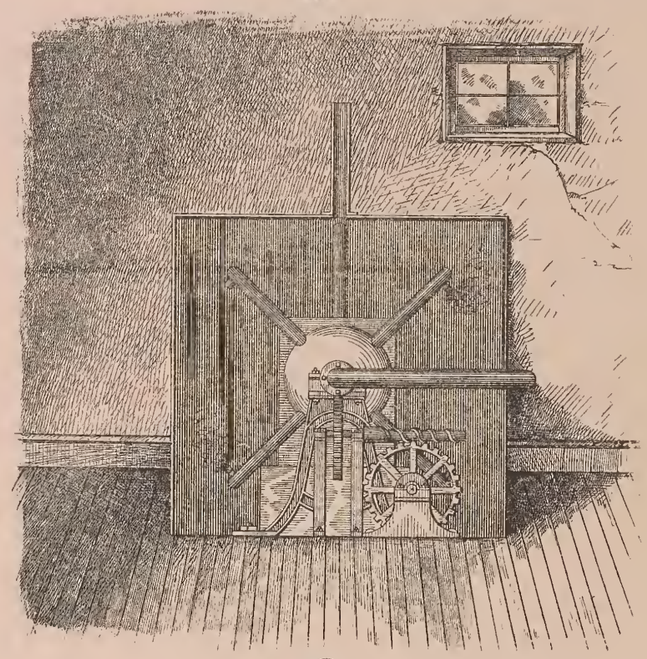
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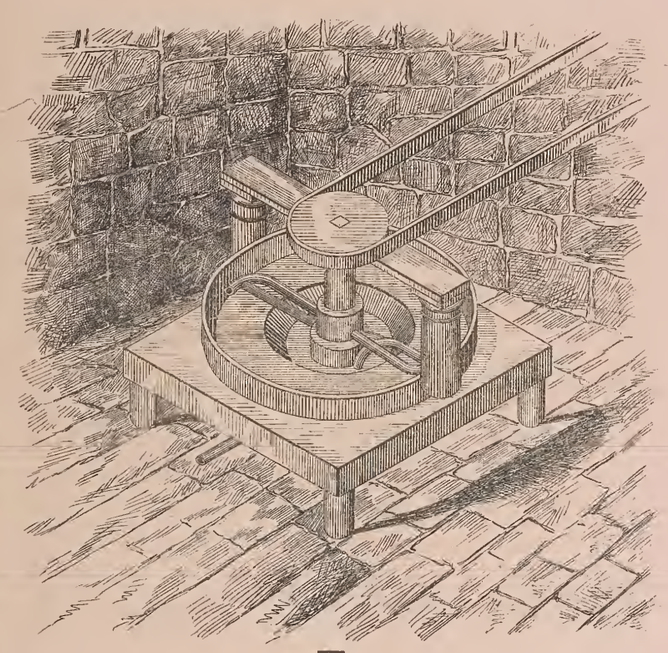
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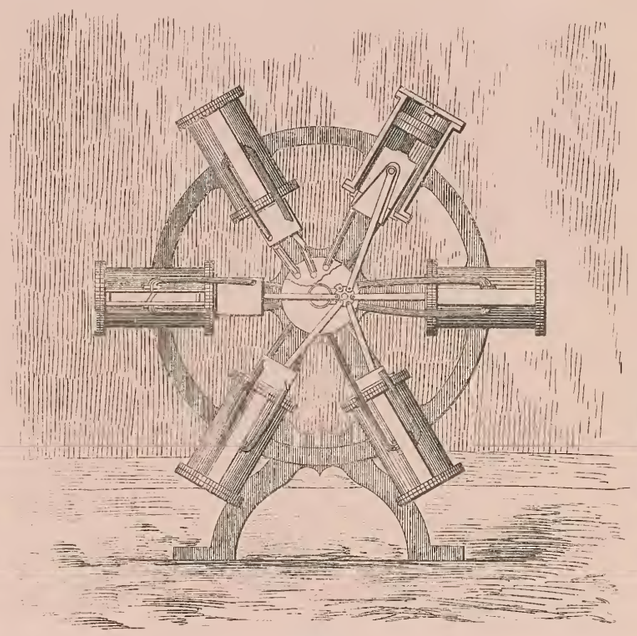
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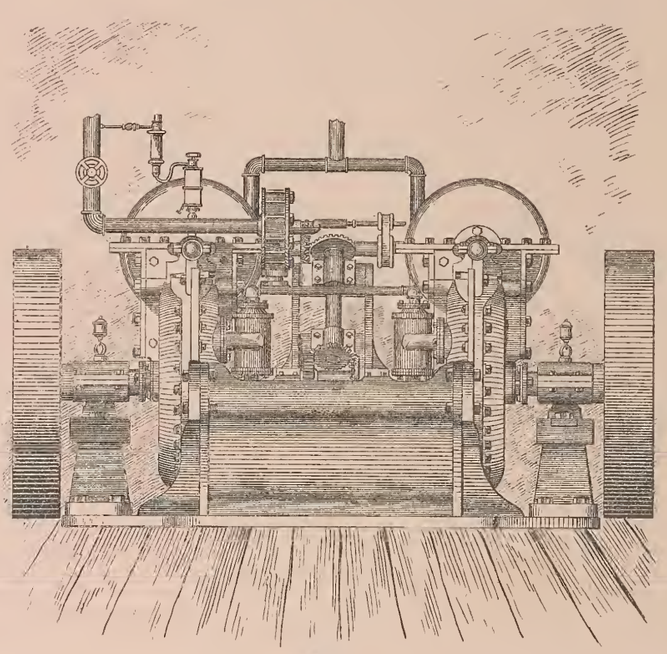
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9

STEAM ENGINES, ROTARY AND OSCILLATING.

STEAM ENGINES---ROTARY & OSCILLATING.

No. 1. Rotary Steam Jet—A. D. 1629.
2. " " Pressure—A. D. 1769.
3. U. S. Patent, Rotary Steam Pressure—A. D. 1816.
4. " " Oscillating—A. D. 1827.
5. " " " —A. D. 1832.
6. " " Reaction Steam Jet—A. D. 1834.
7. " " Steam Jet—A. D. 1845.
8. " " Compound Direct Acting—A. D. 1869.
9. " " Rotary Steam Pressure—A. D. 1882.

The original steam engine was the Æolipile, exhibited in Alexandria, Egypt, 150 B. C. It was a rotary steam engine, the principle being the same as that of the modern turbine water wheel.

Hero, who derived much information from Archimedes, described three modes in which steam could be used as a mechanical power: 1st, to raise water by its elasticity; 2d, to elevate a weight by its expansive power; and, 3d, to produce a rotary motion by its reaction on the atmosphere.

Nerbrest, in his Astronomia Europæa, in 1680, speaks of drawing a car by an æolipile, which ejected the steam upon wings whose axes were geared to the wheels of the car.

The oscillatory cylinder engine was patented in England in 1813.

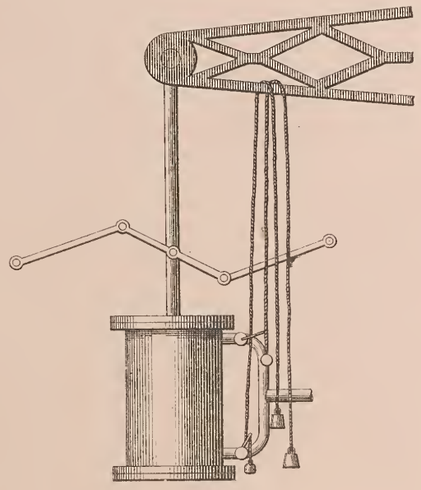
In a rotary engine the piston is attached to a shaft, and revolves with it within a cylinder, the axis of which is parallel with the axis of rotation of the piston or vane.

Oscillating engines have their piston rods attached directly to the crank pin, and as the crank revolves the cylinder oscillates upon trunnions, one on each side of it, through which the steam enters and leaves the steam chest. The valves are within the steam chest, oscillating with the cylinder.

STEAM ENGINES---ROTARY AND OSCILLATING.

921 Patents Granted by the United States.

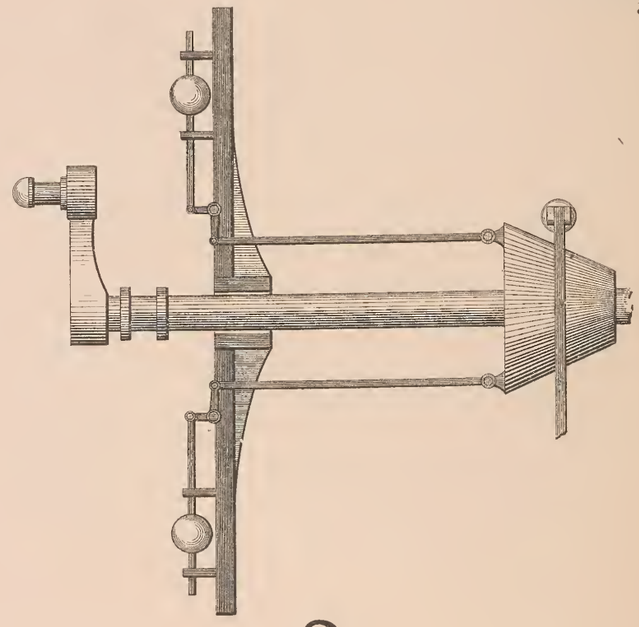
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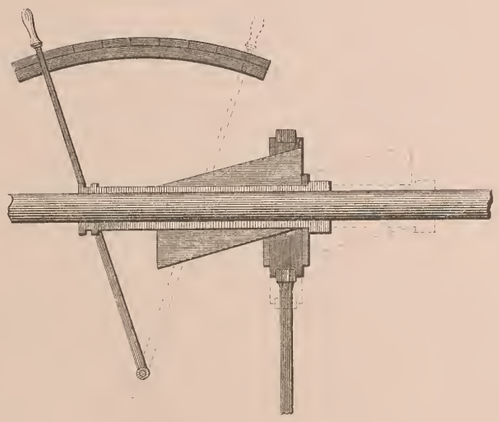
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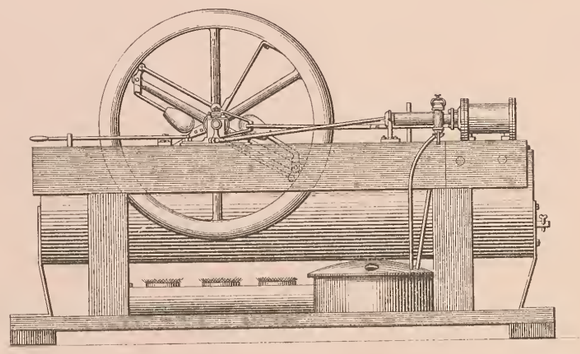
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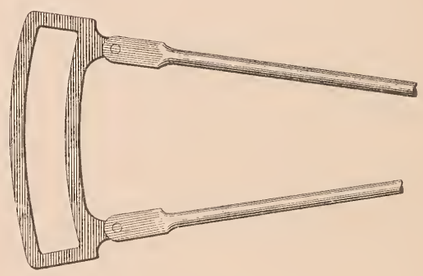
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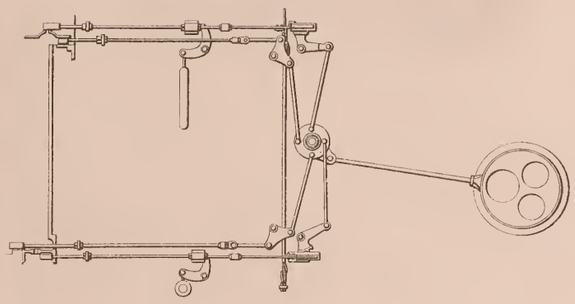
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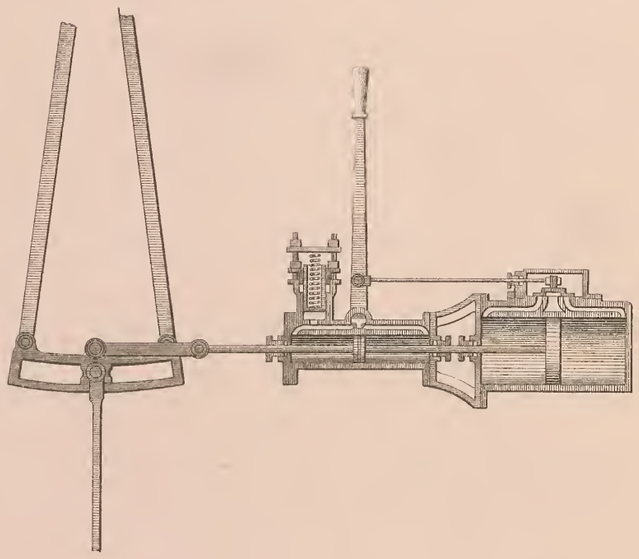
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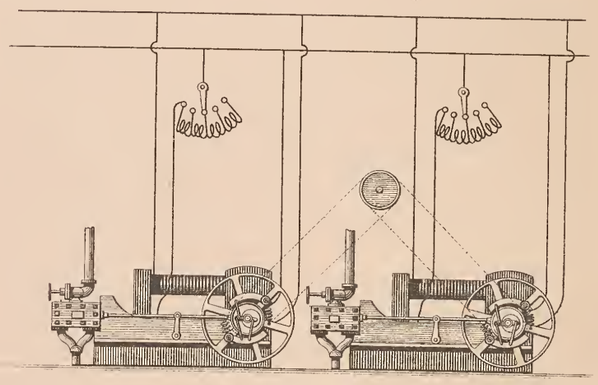
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STEAM ENGINE VALVE GEAR.

STEAM ENGINE VALVE GEAR.

No. 1. Automatic—A. D. 1717.
2. Eccentric—A. D. 1785.
3. English Shifting Cam—A. D. 1802.
4. " Hand Shifting Eccentric—A. D. 1834.
5. U. S. Patent, Fly Wheel Governor—A. D. 1839.
6. " " Link Motion—A. D. 1842.
7. " " Valve Gear—A. D. 1849.
8. " " Link Shifted by Steam—A. D. 1867.
9. " " Electric Generator Engine—A. D. 1883.

The first means of shutting and opening the passages of steam engines were cocks, and as these were all worked by hand the closest and most constant attention was required.

Dr. Papin invented the piston and lever safety valve in 1710.

In 1711 Messrs. Newcomen & Cawley contracted to build a steam engine that would operate pumps for draining a coalery at Griff, Warwickshire, England.

When this engine was on trial the builders were surprised to see it make "several strokes very quick together," when, after a search for the cause of this action, they found a hole in the piston, which let cold water into the cylinder and condensed the steam, whereas, before this, the steam in the cylinder had been condensed by the application of cold water to the outside.

This circumstance led to the application of a jet of water into the cylinder. In order to cause this jet of water to enter the cylinder at the right time, which was at the completion of the stroke of the piston, a float was so arranged in a pipe at the side of the cylinder that when the steam was strong it would rise and open the injection valve. This was a self-actuated valve gear, but with it only from six to ten strokes of the piston per minute could be attained.

Finally, Humphrey Potter, a boy who attended the engine, in 1713, added what he called a "scoggan," which was a catch that the beam always opened so that the piston would make as high as sixteen strokes per minute.

This device was used for several years, but "being perplexed with catches and strings, Mr. Henry Beighton, in an engine he had built at Newcastle-upon-Tyne, in 1718, took them all away but the beam itself, and supplied them in a much better manner."

Watt introduced the rotary ball governor, throttle valve, steam gage, indicator and register.

The detachable, adjustable, or drop cut-off valve gear was patented by Frederick E. Sickels, of New York City, in 1842.

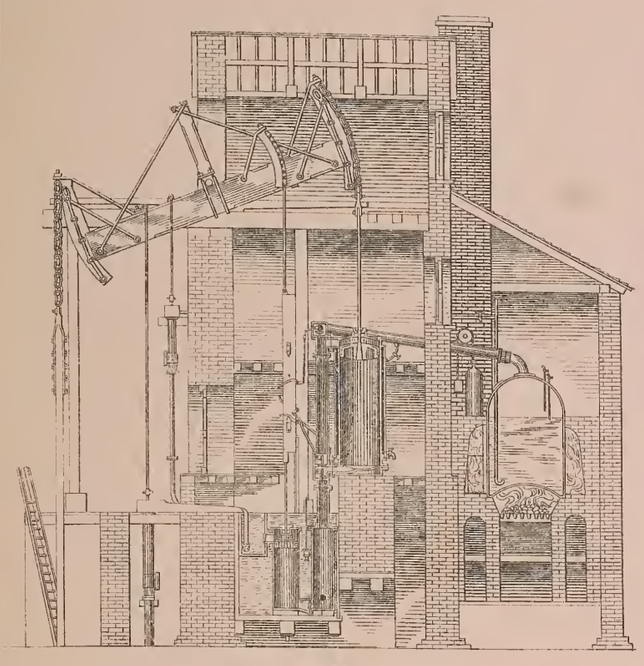
The application of the governor to determine the point of cut-off was made by Zackariah Allen and George Corliss, of Rhode Island, in 1849.

The valve gear is the system of valves and of actuating mechanism which distribute the steam as the engine passes through its cycle of motion.

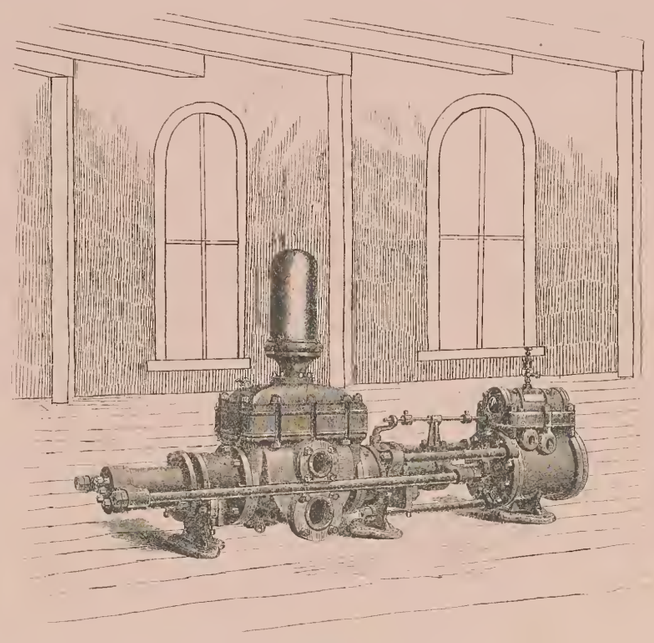
STEAM ENGINE VALVE GEAR.

679 Patents Granted by the United States.

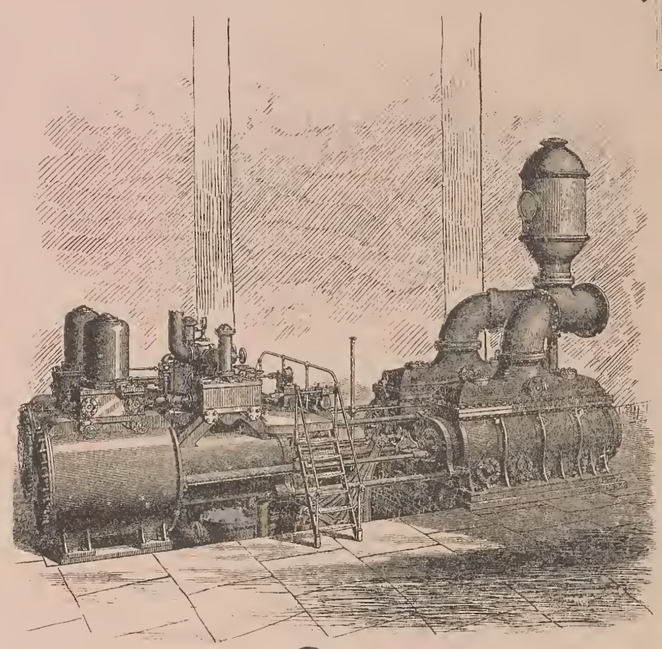
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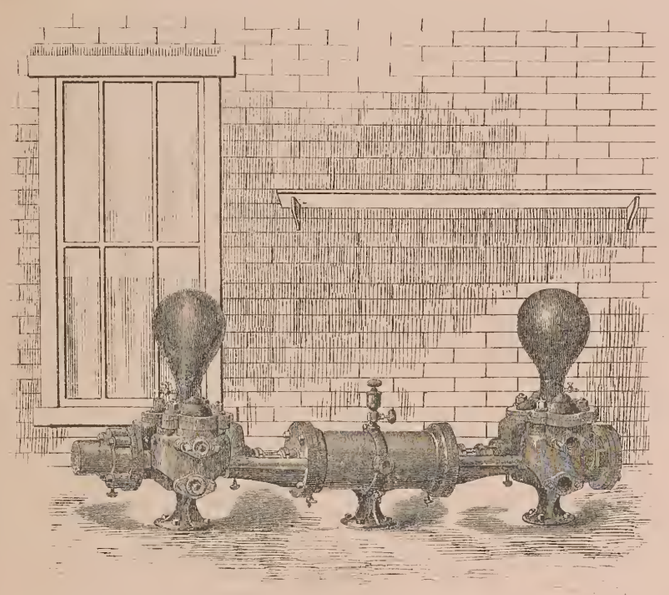
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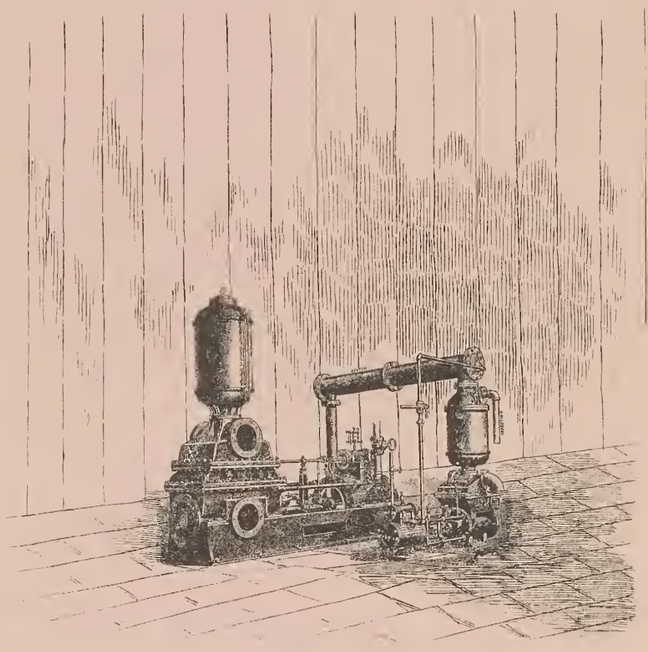
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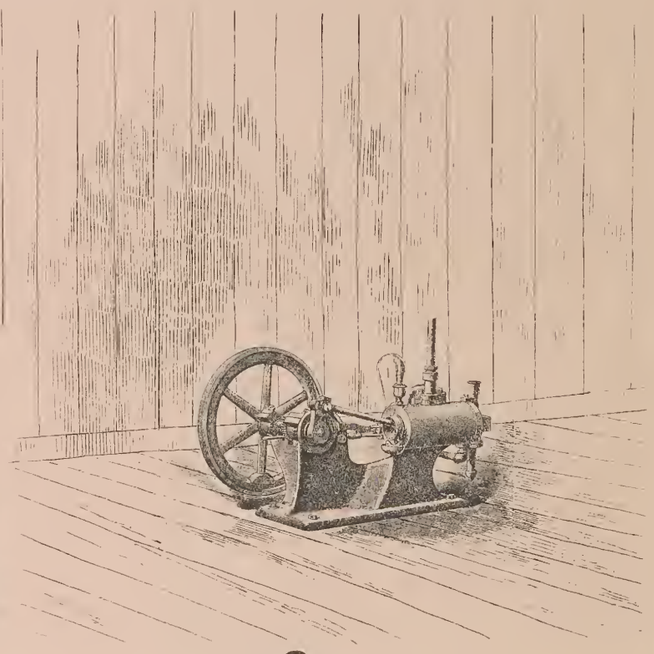
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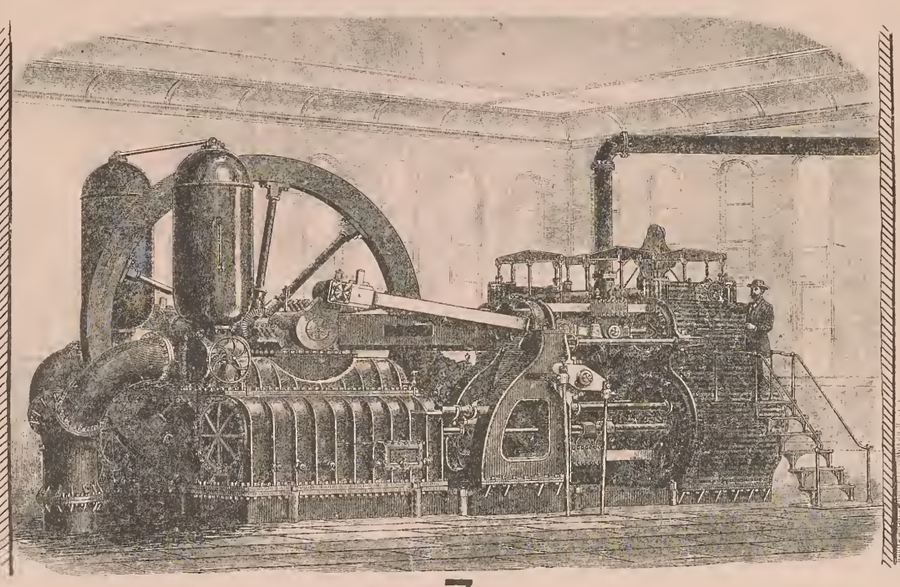


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STEAM PUMPING ENGINES.

STEAM PUMPING ENGINES.

No. 1. Single Acting Pumping Engine—A. D. 1774.
2. U. S. Patent, Double Plunger Mining Pump—A. D. 1870.
3. " " Duplex Pumping Engine—A. D. 1875.
4. " " Double End Steam Pump—A. D. 1876.
5. " " Steam Pumping Engine—A. D. 1881.
6. " " Gas Motor Applied to Pumping—A. D. 1883.
7 " " Compound Pumping Engine—A. D. 1883.

The Marquis of Worcester, in his "Hundred Inventions," published in 1663, mentions a number of experiments which he made of the expansive power of steam, and claims that his attention was directed to this subject by an incident which occurred while he was a prisoner in the Tower of London. He had been preparing some food over a fire when the cover of the vessel was suddenly driven with great violence up the chimney. While this story is probably apocryphal, it is believed that the Marquis invented an engine which he thought could be made conducive to the public interests in raising water from pits or wells, and this engine was afterwards recommended to Louis XIV by Sir Samuel Morland for the purpose of irrigating the grounds at St. Germain. The Marquis is claimed as the inventor who discovered a mode of applying steam as a mechanical agent, and he secured the passage by Parliament of an act to enable his heirs fornenety-nine years to receive the sole benefit, profit and advantage from, as he termed it, his "water commanding engine."

This engine was, however, incomplete and crude.

In 1698, Captain Savary obtained a patent for a new method of clearing coal and other mines of water, and he may be justly considered as the first person who rendered steam applicable to manufacturing purposes.

Savary's engine was employed with good results in the drainage of mines in Cornwall and Devonshire, England.

The engines of the Marquis of Worcester, Savary, Papin and Newcomen, were all pumping engines.

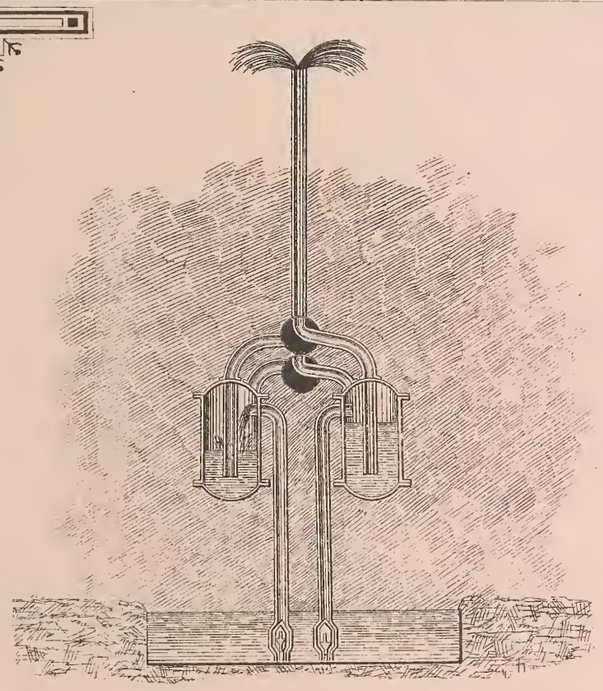
Oliver Evans, of Philadelphia, was one of the first, if not the first inventor, to apply the high pressure principle to the steam engine, and he succeeded in introducing it into quite general use in this country before his death. In the year 1817, he constructed a pumping engine for the Fairmount Water Works, the boilers for which were worked at a pressure of 200 pounds to the square inch, but after two explosions the engine was abandoned and water wheels introduced.

The largest stationary engine in the world is at the famous zinc mines at Friedensville, Pa. It is known as "The President," and it is said that there is no pumping engine in the world that can compare with it. Its regular work is to raise 17,500 gallons of water every minute, and it has raised as high as 19,000 gallons in a minute, from a depth of 350 feet. The driving wheels are 35 feet in diameter, and weigh 40 tons each. The sweep rod is 40 feet long, the cylinder 110 inches in diameter, and the piston rod 18 inches in diameter, with a 10-foot stroke.

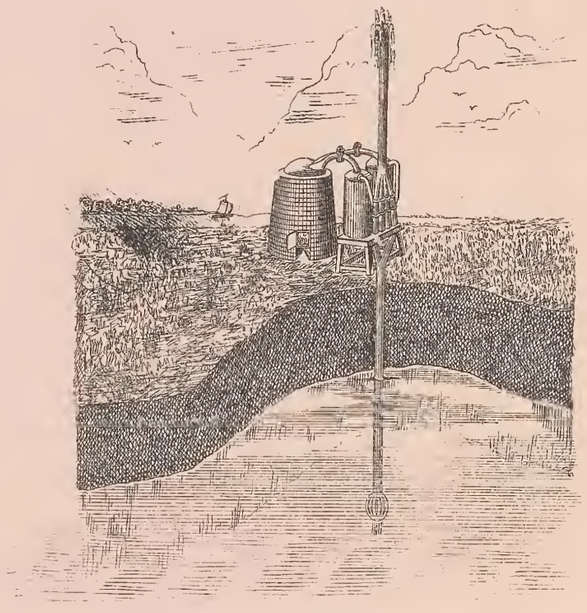
STEAM PUMPING ENGINES.

217 Patents Granted by the United States.

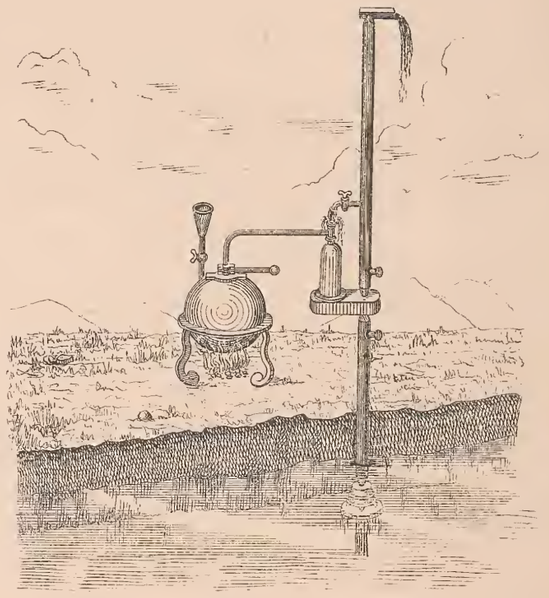
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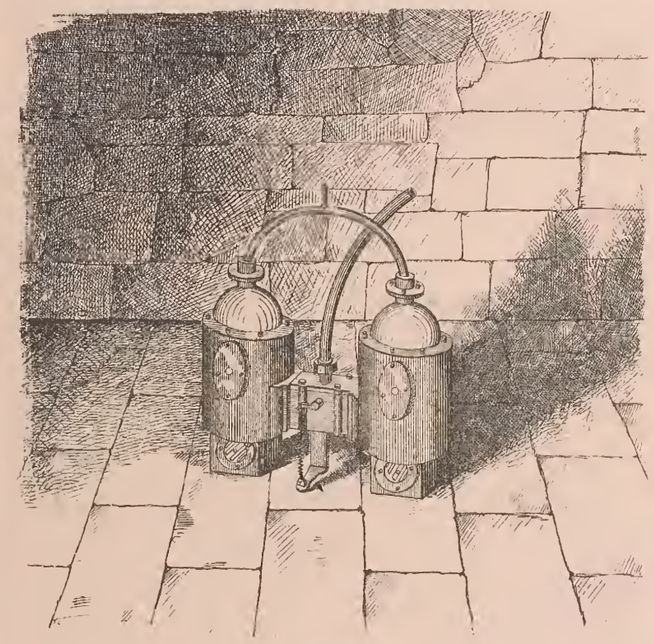
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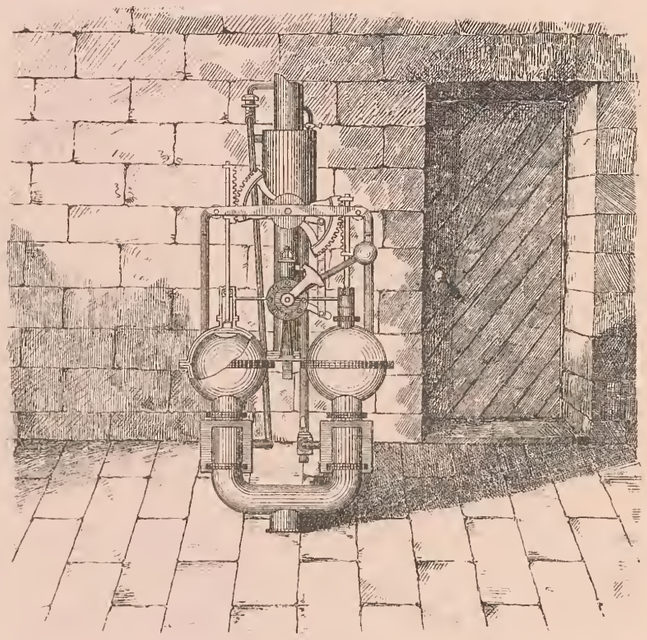
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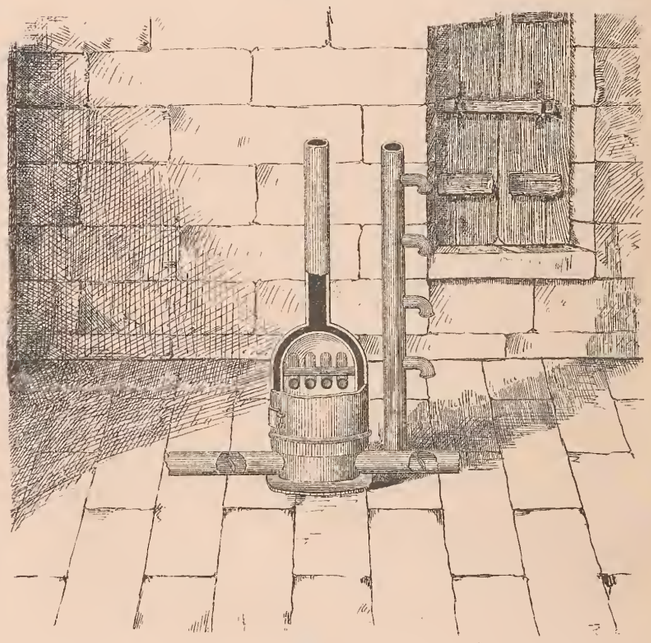
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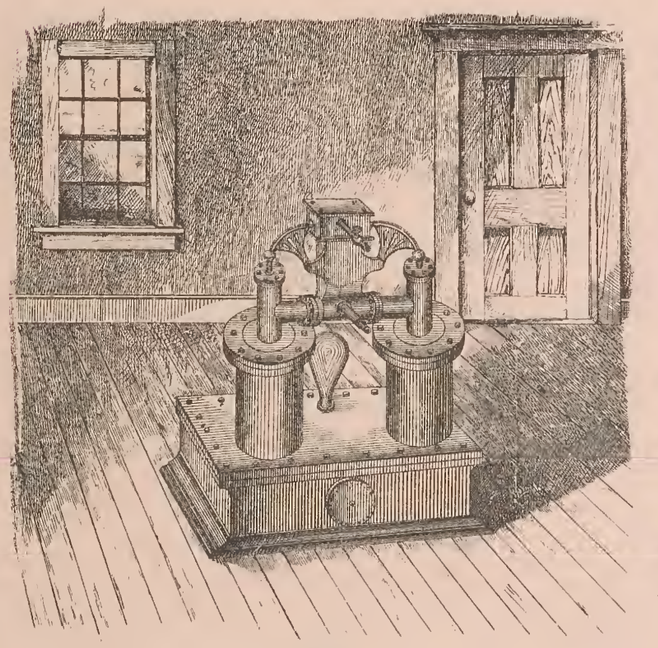
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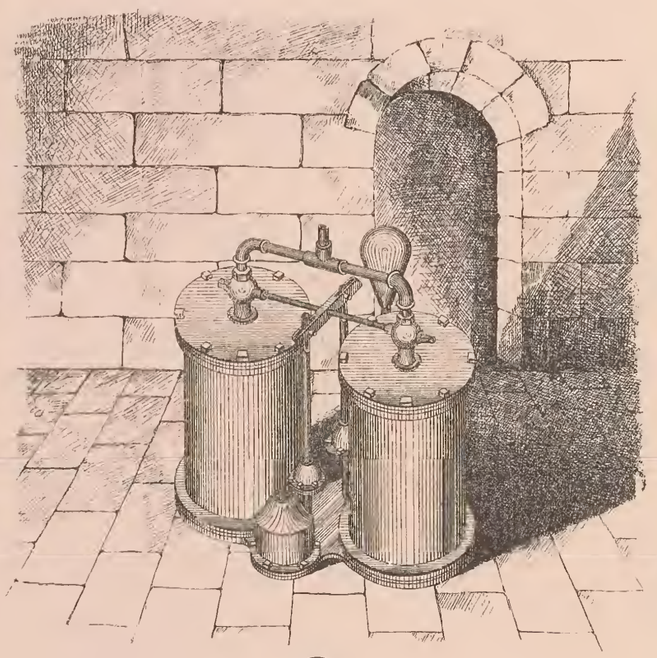
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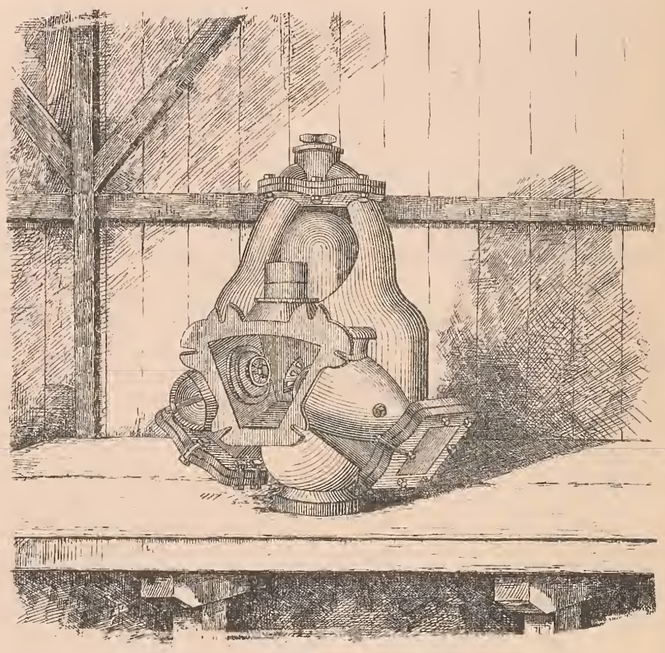
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STEAM AND VACUUM PUMPS.

STEAM AND VACUUM PUMPS.

No. 1. Steam Vacuum Mining Pump—A. D. 1665.
2. " " " " —A. D. 1698.
3. " " " " —A. D. 1698.
4. U. S. Patent, Steam Vacuum Pump—A. D. 1842.
5. " " " " —A. D. 1853.
6. " " Hot Air Water Elevator—A. D. 1854.
7. " " Steam and Vacuum Pump—A. D. 1856.
8. " " " " " —A. D. 1872.
9. " " Steam Vacuum Pulsometer—A. D. 1881.

Papin of France, in 1695, added more to the invention of the steam engine than all of his predecessors; and, speaking of the extent to which steam could be applied, states that "his principle could be applied to removing water from mines, throwing bombs, &c."

Savary's steam-pumping engine was employed with good results in the drainage of mines in Cornwall and in Devonshire, England, in 1705.

The earliest application of a steam engine to a pump is accorded to Newcomen, in 1713.

Oliver Evans, in 1817, constructed a pumping engine for the Fairmount Water Works, of Philadelphia, Pa.

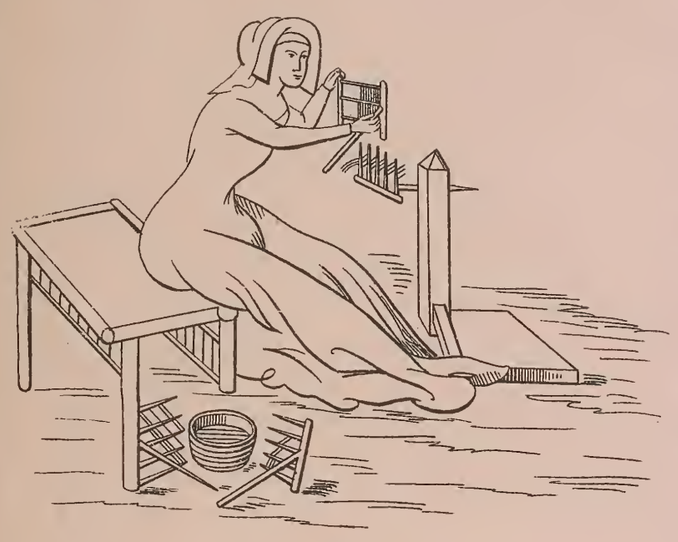
Steam pumps are important among the engineering devices of the day.

The necessity of pumping water from mines, from ponds in draining, or from sunken vessels, coffer dams or wet excavations, has given great importance to that special application of the steam engine.

STEAM AND VACUUM PUMPS.

165 Patents Granted by the United States.

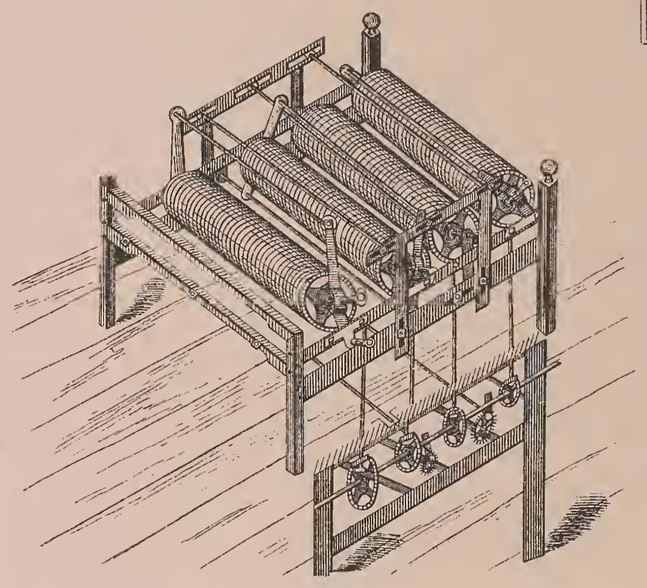
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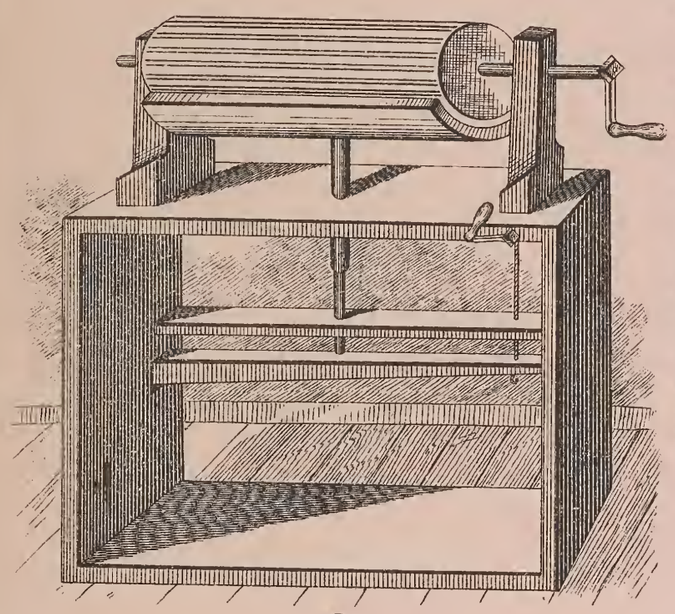
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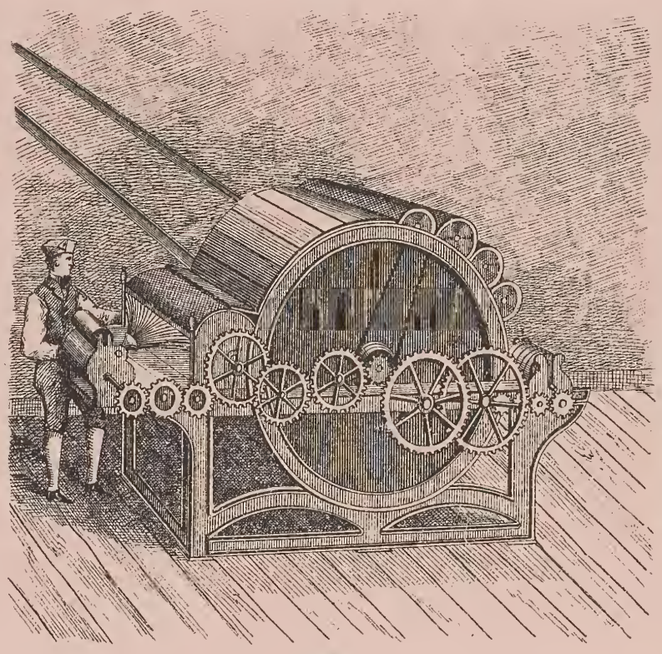
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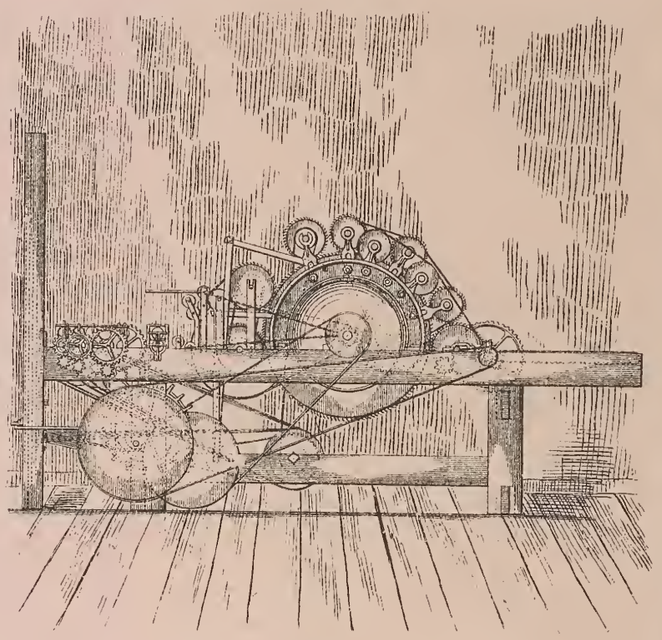
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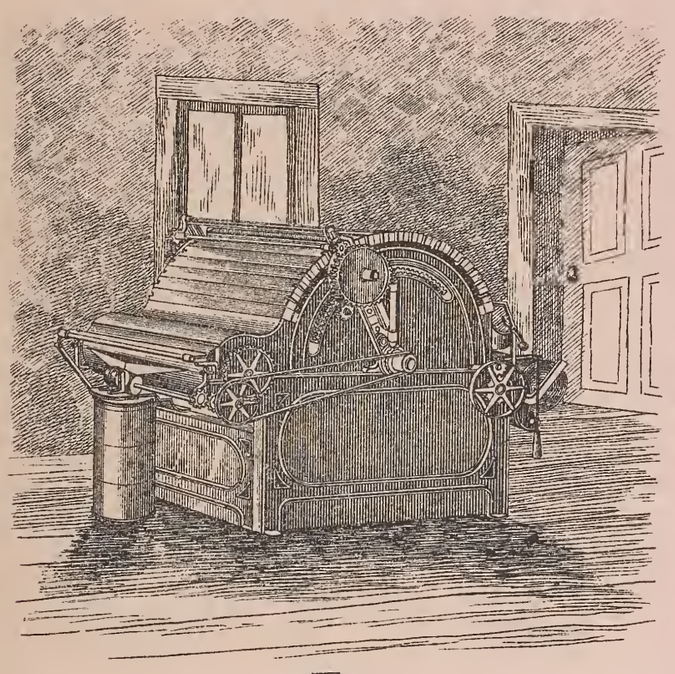
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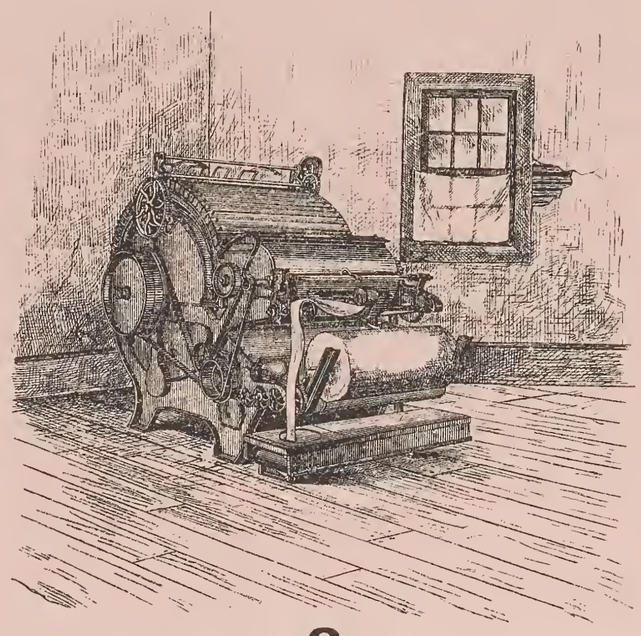
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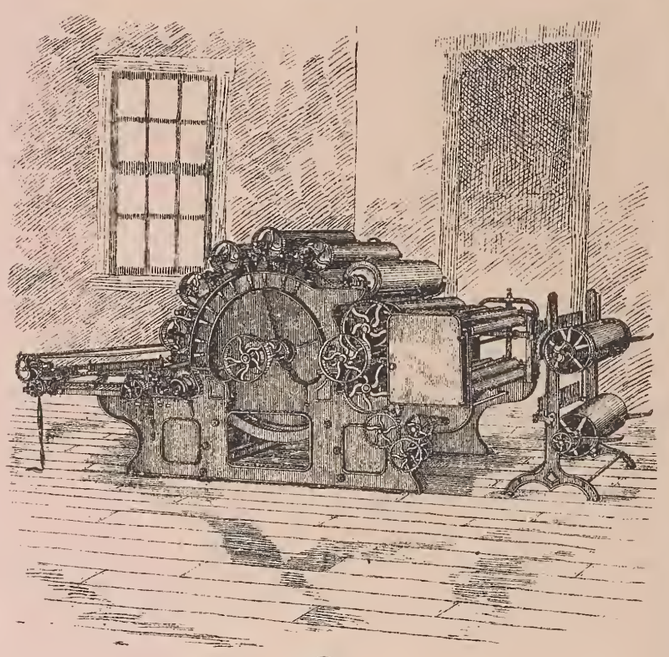
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9

CARDING.

CARDING.

No. 1. Primitive, Carding Wool, Hand.
2. " " Cotton, Hand.
3. English Carding Wool or Cotton Machine—A D. 1748.
4. " " " " " —A D. 1748.
5. Automatic Carding Machine—A. D. 1773.
6. U. S. Patent, Wool Carding Machine—A. D. 1810.
7. " " Automatically Stripping Top Flats—A. D. 1857.
8. " " Cotton Carding Machine—A. D. 1884.
9. " " Wool " " —A. D. 1884.

The earliest authentic mention of carding describes two flat surfaces studded with teeth, one being nailed to a bench and the other having a single handle by which it could be moved back and forth over the fixed card upon which the cotton was placed.

The first improvement consisted in suspending the movable flat by two cords which passed over pulleys and had weights at the other ends.

The next improvement was made in 1748, by Peel, of England, who patented two different carding machines. His invention met with no success. Twelve years later it came into use, with slight improvements, as the invention of Hargreaves. In 1762 Peel employed Hargreaves to erect a cylinder carding machine in a mill at Blackburn, England.

The greatest step of all was taken in 1773, when Richard Arkwright invented his power card, which consisted of a main cylinder working against top flats, the cotton being fed into the card by fluted rolls and removed by a doffer and doffer comb.

As the cotton is drawn between the cylinder and each flat in the carding process, the action of the cylinder teeth disentangles and straightens the fibres, and lays them parallel.

Since Sir Richard Arkwright's invention, improvements in the cotton card have consisted mainly of modifications of the same general plan.

The first carding machine established in America was constructed and set up at Pittsfield, Mass., in 1801.

Cards in use fifty years ago had but ten flats each. A subsequent improvement consisted in making the frame of iron instead of wood, and using fourteen flats, covering a trifle over a quarter of the surface of the cylinder.

In 1862 cards were built with twenty flats, covering a little over one-third of the circumference, and twelve years later the distinction of "top flat" and "under flat" arose.

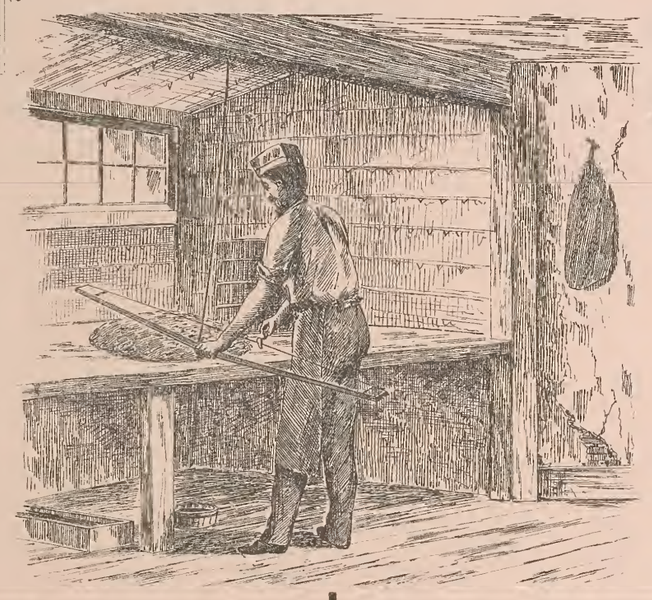
Great improvements have been made in top flat cards, and they are sometimes built with twenty-seven flats one and one-half inches on the wire in width.

Cards are distinguished by quality, as sheet card, fillet card, breaking card and top card.

CARDING.

751 Patents Granted by the United States.

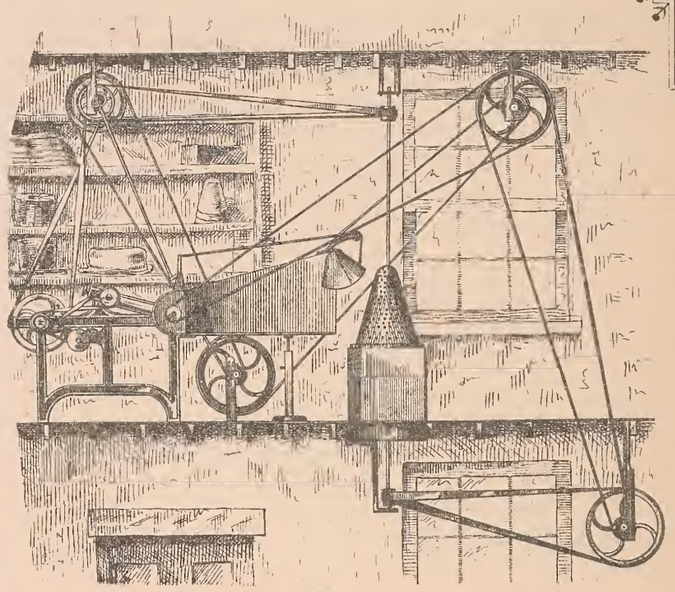
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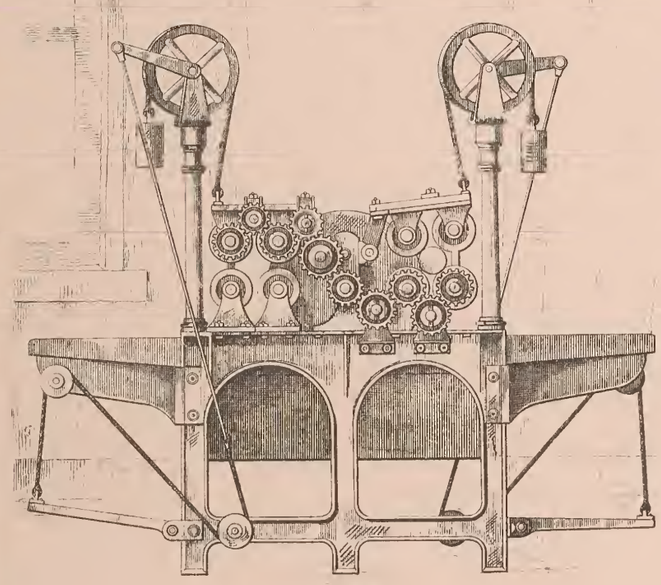
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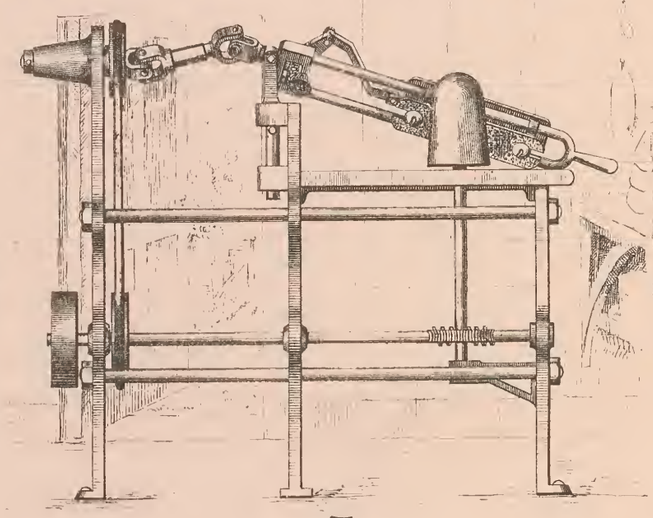
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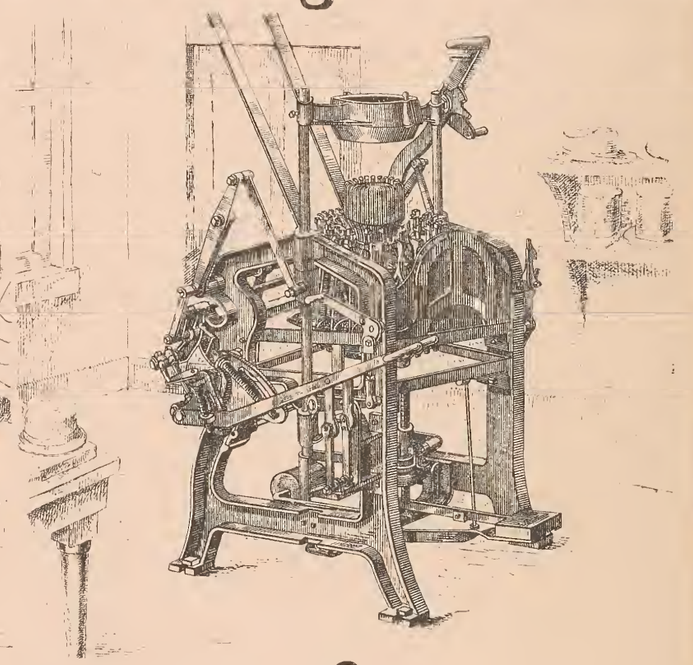
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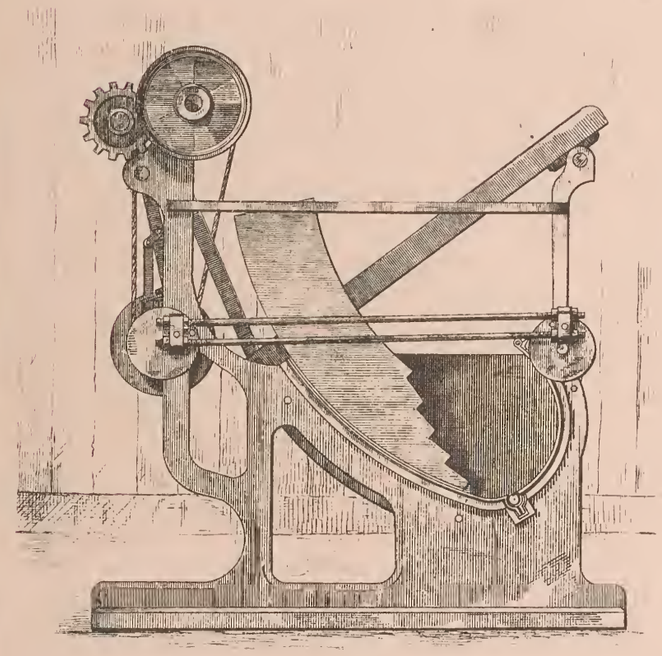
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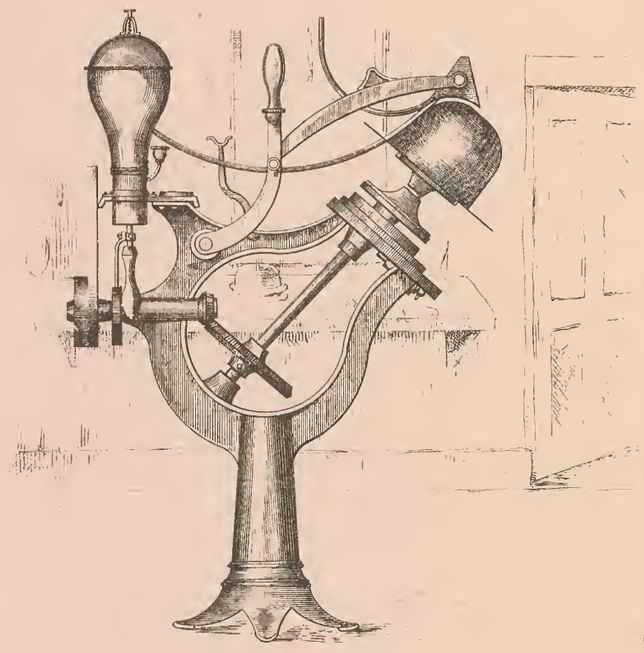
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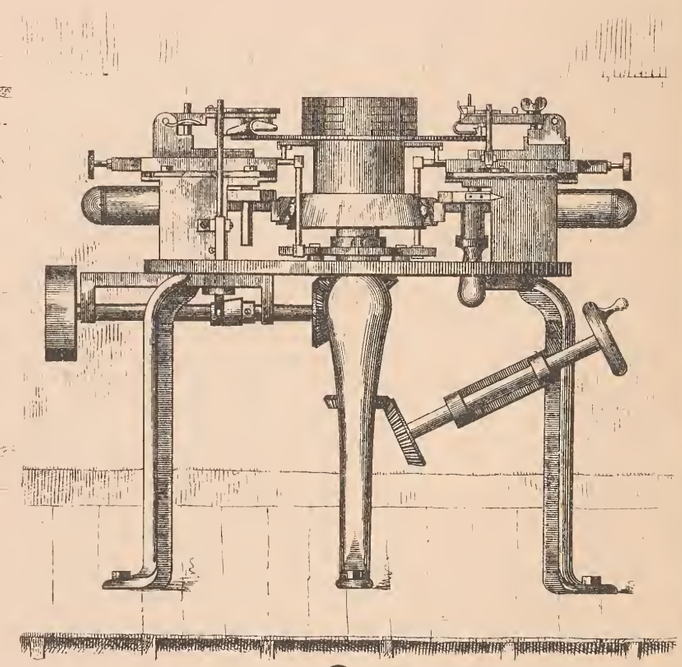
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9

FELTING AND HATS.

FELTING AND HATS.

No. 1. Primitive Forming Bats—Bowing.
2. " Felting Hats.
3. U. S. Patent, Forming Bats—A. D. 1846.
4. " " Felting Hats—A. D. 1870.
5. " " Pouncing Hats—A. D. 1879.
6. " " Blocking and Shaping Hats—A. D. 1881.
7. " " Fulling Mill—A. D. 1881.
8. " " Ironing Hats—A. D. 1883.
9. " " Curling Hat Brims—A. D. 1884.

Felt probably preceded woven fabrics.

In Central Asia, the home of the Argali, the clothing and tents of the people are yet, and have been since time immemorial, made of felted fabrics.

The latticed huts, referred to by Herodotus, were covered with felt. The Chinese traveler, Chi fa ham, who visited India in the 4th century, describes the people who live about the Lake of Lob as wearing dresses of Chinese cut, made of felt.

Felt covered the funeral pile of Hephæstin, whose obsequies were so splendidly celebrated by Alexander.

The principal use of felt among the Greeks and Romans was in the manufacture of hats.

The art of felting, no doubt, passed from Central Asia into Greece in the time of Aristotle.

The felt mantles of Circassia to this day are heavy, stiff, and rain proof.

The Armenians of Schamachi lead a nomadic life in huts constructed of wicker work covered with felt.

Hatters attribute the art of felting to Clement.

Dr. Hooke lectured on Felt Making before the Royal Society of England in 1666.

The hair of rabbits and other animals is used in Russia as a felt foundation for bowls, dishes, plates, &c.; after completion they are varnished and resemble papier mache. The uses of felt are various. Among them may be cited the following: Among the Asiatics, cloth hats, tent coverings, sacks, &c. In the United States and Europe, for domestic purposes; cloth, clothing, socks, slippers, boot and shoe soles, carpets, hats, caps, gloves, table covers, steam boiler coverings, dealing for walls, non-conductors for kilns and refrigerators, roofing, steam packing polishing wheels, &c., &c.

Felt hats are as old as Homer. The Greeks made them in various forms.

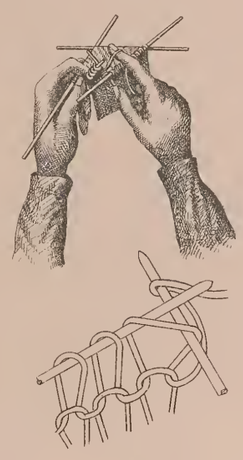
In 1449 Charles VII made his triumphal entry into Rome, wearing a felt hat lined with red velvet and surmounted with a plume of feathers; this set the fashion, and hats soon superseded chaperons and hoods. Felt hats are said to have been introduced into England in 1470.

The use of the fur of the beaver, which dates back to 1585, threatens to become obsolete. It is to a great extent superseded by the imitation made by covering a body with silk plush.

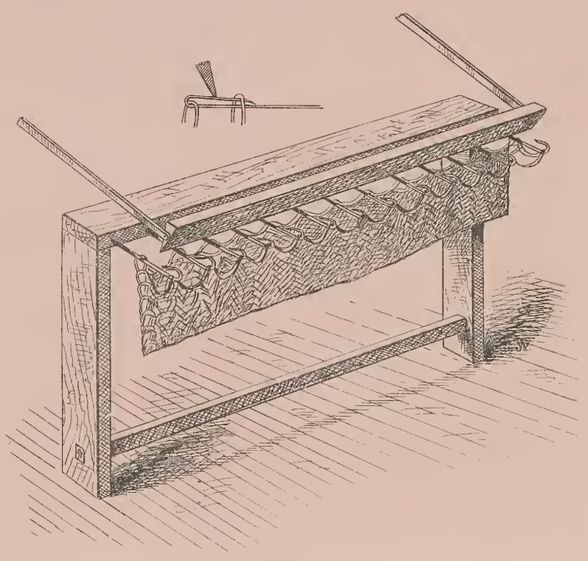
FELTING AND HATS.

1,372 Patents Granted by the United States.

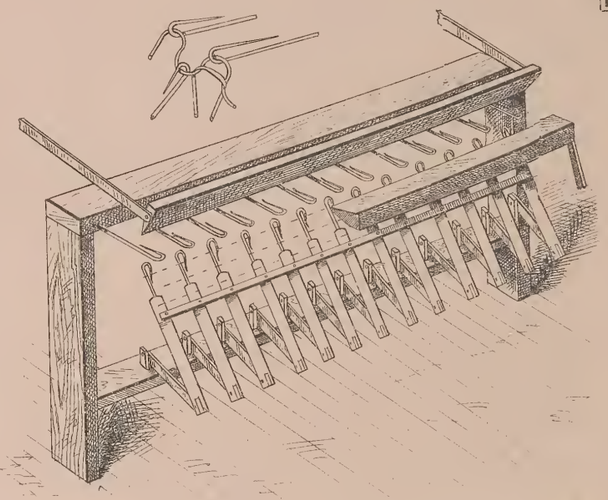
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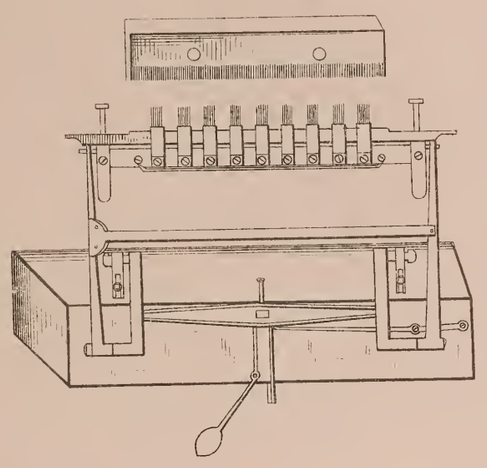
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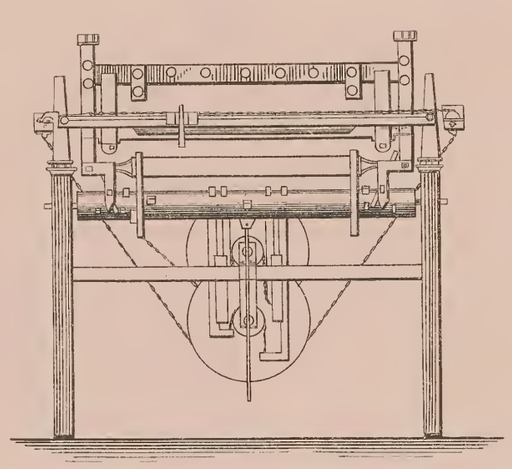
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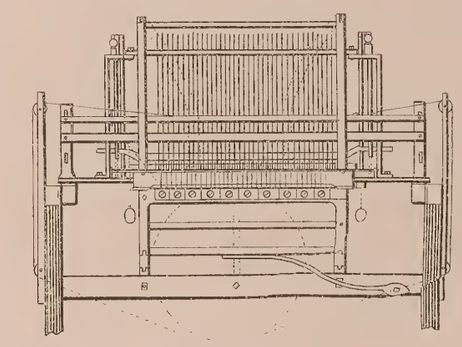
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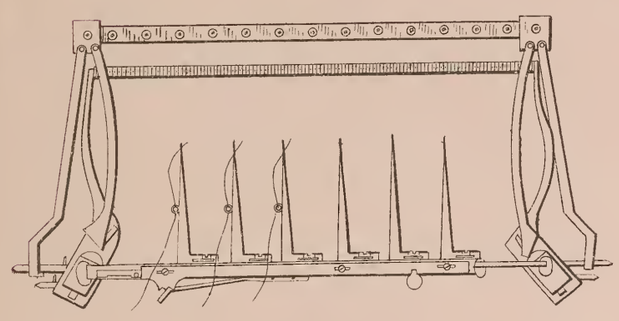
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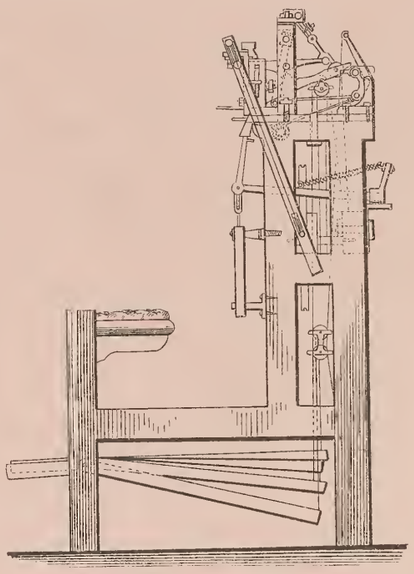
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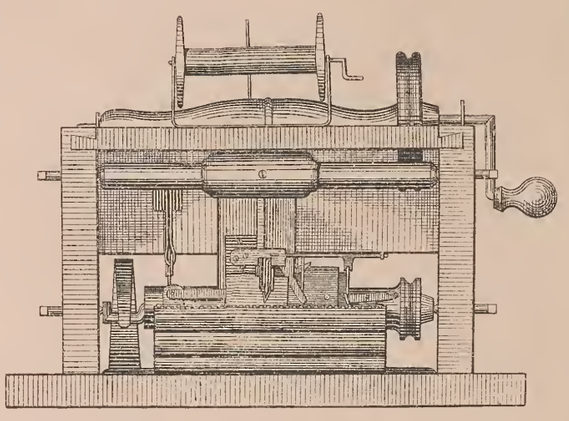
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KNITTING.

KNITTING.

No. 1 Primitive Hand.
2. Knitting Machine—A. D. 1589.
3. Rib Knitting Machine—A. D. 1756.
4. Ribbing Attachment to Frame—A. D. 1759.
5. Widening and Narrowing Attachment—A. D. 1769
6. Knitting Machine—A. D. 1777.
7. Attachment to Knit Several Breadths—A. D. 1782.
8. Stocking Frame—A. D. 1784.
9. U. S. Patent, Straight Knitting—A. D. 1837

Knitting, derived from the Saxon word "crittan," meaning threads woven by hand, is the art of making a textile fabric by interlooping yarn or thread by means of needles of any character.

Its origin was probably in Scotland, whence it was taken to France, where a company of stocking-knitters was established in 1527, under the patronage of St. Fiacre, a Scottish recluse of the seventh century.

According to other accounts, the practice of knitting was first known in Italy or Spain. So far as silk stockings are concerned, it is quite probable that they were first knit in Spain, for the first record of them in England is that a pair of them was presented to King Henry VIII from Spain.

The word knit applied to stockings must have been common in England in 1530, as at that time a grammar was published by the French master to the Princess Mary, daughter of Henry VIII, in which the verb to knot or knitt is mentioned: "I knitt bonnets or hosen, je lasse;" and from an authentic and curious household book, kept during the life of Sir Thomas L'Estrange, Knight, are the following entries: "1533, 7th Sept., peyd for 4 peyr of knytt hose, viii s.; 1538, 3d Oct., peyd for 2 peyr of knytt hose, 1 s.;" the former being for Sir Thomas himself and the latter for his children.

Stockings, or coverings for the legs, had been worn since the time of the Roman Empire, but they were mostly of cloth or skin, and so when the knitting of woolen stockings was learned in England it became quite an industry.

Silk knit stockings came into England from Spain, and were very rare.

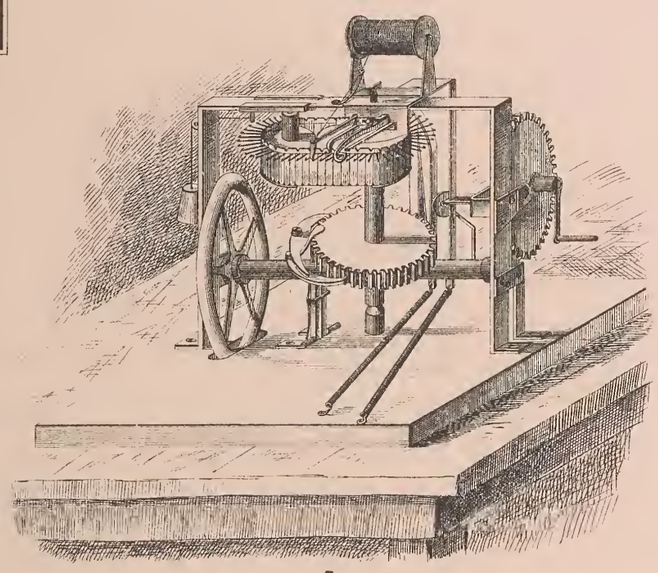
The first pair of silk stockings knit in England was presented to Queen Elizabeth by Mrs. Montague, her silk-woman, and it is stated that Her Majesty was so well pleased that from thenceforth she never wore cloth hose any more.

The hand-knitters employed long pins or needles in this work, and the art of knitting became an extensive business and support for the peasantry of England.

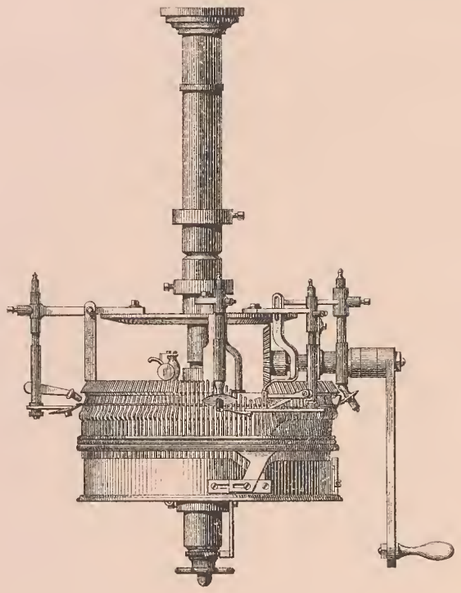
KNITTING.

765 Patents Granted by the United States.

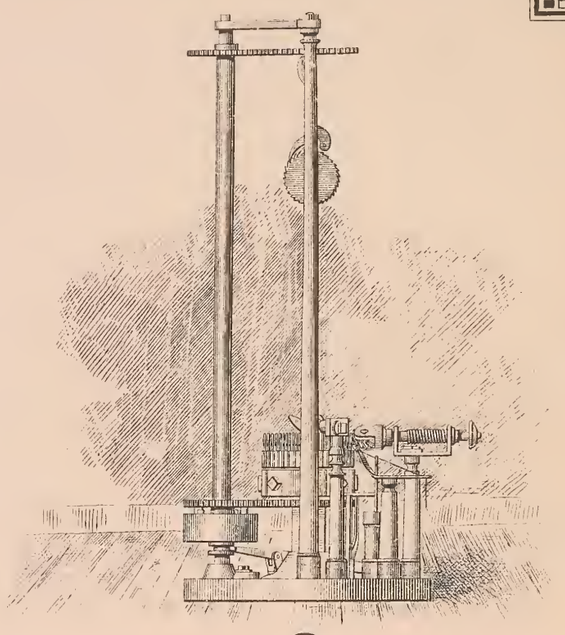
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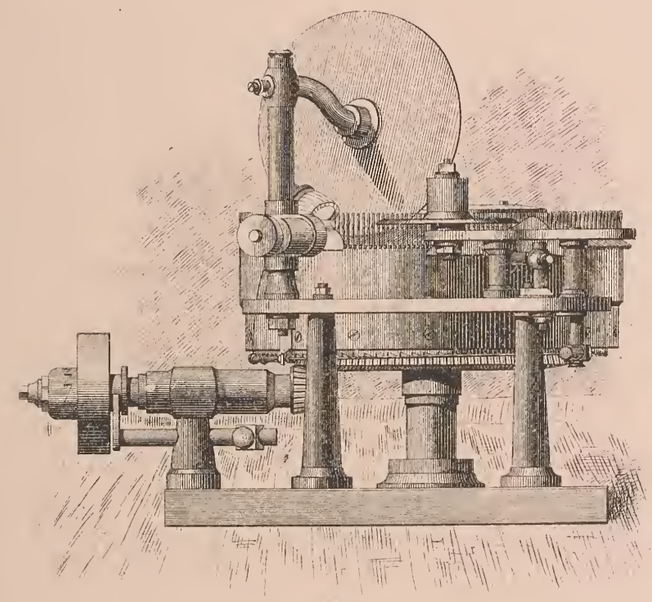
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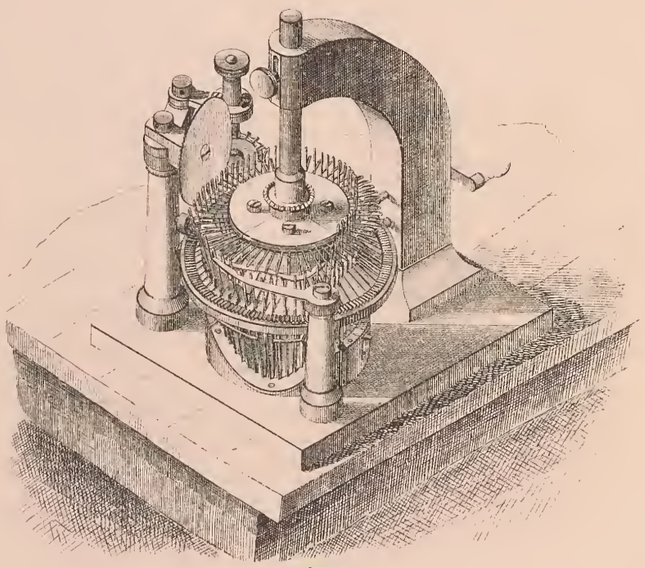
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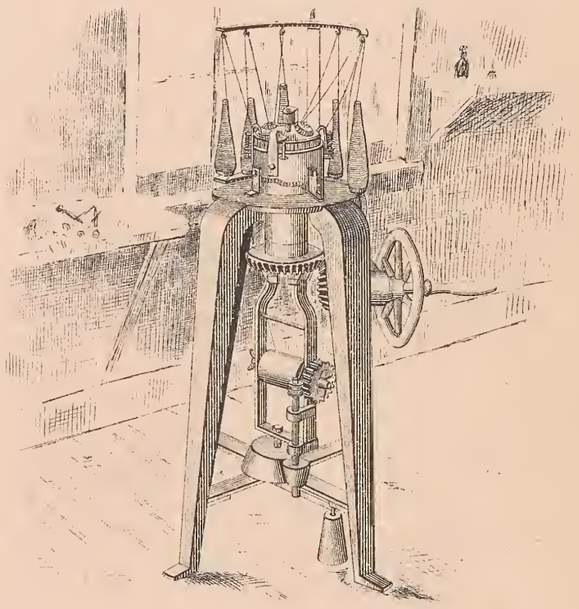
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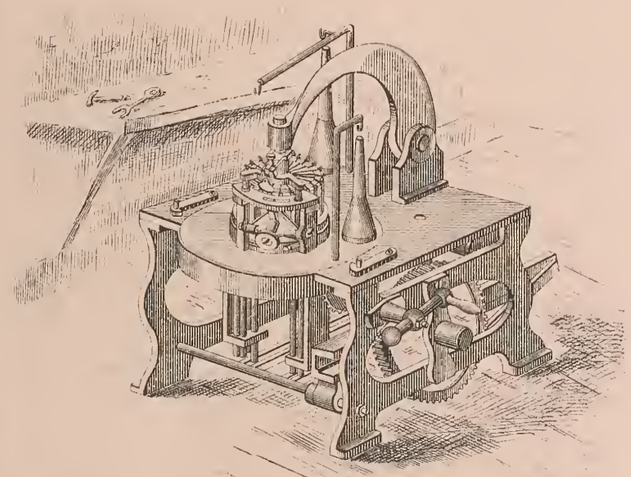
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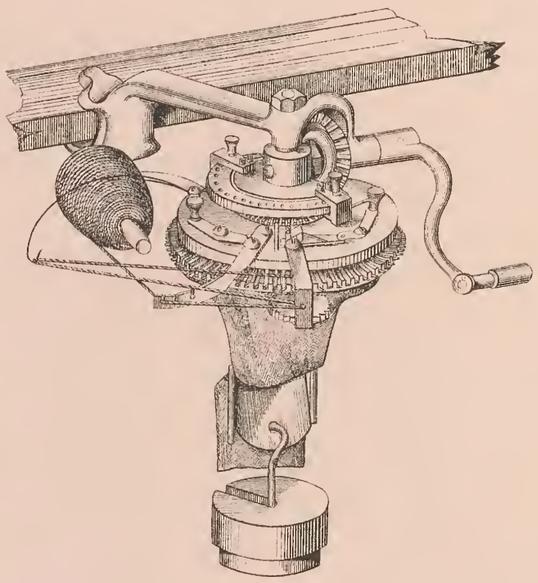
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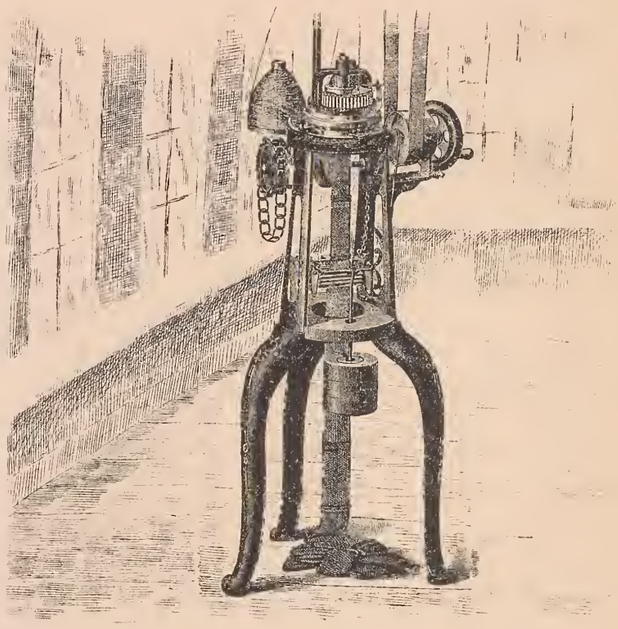
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KNITTING--CIRCULAR MACHINES.

KNITTING---CIRCULAR MACHINES.

No. 1. U. S. Patent, Endless Chain of Needles—A. D. 1840.
2. " " Four Feed Machine—A. D. 1844.
3. " " Vertically Arranged Needles—A. D. 1852.
4. " " Levers to Lift Stitches over Vertically Arranged Needles—A. D. 1854.
5. " " Knitting Circular Ribbed Fabrics—A. D. 1855.
6. " " Weft Thread Knitting—A. D 1870.
7. " " Knitting Shaker Sock, Ribbed Leg—A. D. 1874.
8. " " Radially Reciprocating Needles—A. D. 1881.
9. " " Knitting Ribbed Tops of Stockings—A. D. 1884.

Stockings were probably first woven in this country at Chester, Pa., in 1723, and the frames were brought over by the Germans, as the English Government placed a prohibition upon the exportation of stocking frames into the Colonies.

The State of Virginia, in 1662, offered a premium of ten pounds of tobacco for every dozen pairs of woolen or worsted stockings; and the knitters of coarse yarn stockings in Pennsylvania are said to have received one-half crown a pair in 1698.

In 1766 the Society of Arts of New York offered a prize of ten pounds for the first three stocking looms of iron; and in 1776 the Committee of Safety of Maryland appropriated three hundred pounds to Mr. Coxendefer, of Frederick County, to establish a stocking factory.

In 1758 Jedediah Strutt invented "a machine for making turned ribbed stockings and other goods," and in 1775 a Mr. Crane, of Edmonton, England, succeeded in applying warp to the stocking frame.

The circular knitting machine was invented in 1816 by a Mr. Brunel, who called it "The Tricoteur," but it was not until 1847 that the "latch needle," now so commonly used, was invented. While this invention is claimed both in England and France, it is held in this country to have been made by Mr. Aiken, of New Hampshire.

In 1831 Timothy Bailey, of Albany, N. Y., succeeded in applying power to the old stocking frame of Lee, and in the following year the manufacturing of hosiery by steam or water power was first commenced in this country at Cohoes, N. Y.

The invention of knitting lace is attributed to Barbara, the wife of Christopher Haltman, a German miner in 1560. At that time, the mines being unproductive, the women employed themselves in making nets, and the lace which they manufactured, on account of the low price of labor, soon became fashionable and superseded the Italian lace worked with a needle.

A manufacture of lace was established in France in 1566.

Flanders has long been celebrated for its lace, and it is said that an ounce of fine Flanders thread has been sold in London for four pounds, which might be made into lace of the value of forty pounds, ten times its weight in gold.

About 1760 Morris and Betts made an improvement upon Strutt's invention, mentioned above, which laid the foundation of modern machine-wrought lace, and in 1769 the first figured lace web was made by Robert Frost, on a frame arranged by Thomas Taylor, of Nottingham, England.

About twenty years ago the machine to knit a circular and seamless webb was invented. This gave a a new impetus to American hosiery.

On hosiery and knit goods there are now engaged about a hundred and fifty mills, almost wholly supplying the market. Some of the departments of manufacture are new since 1867, and a large share since 1864.

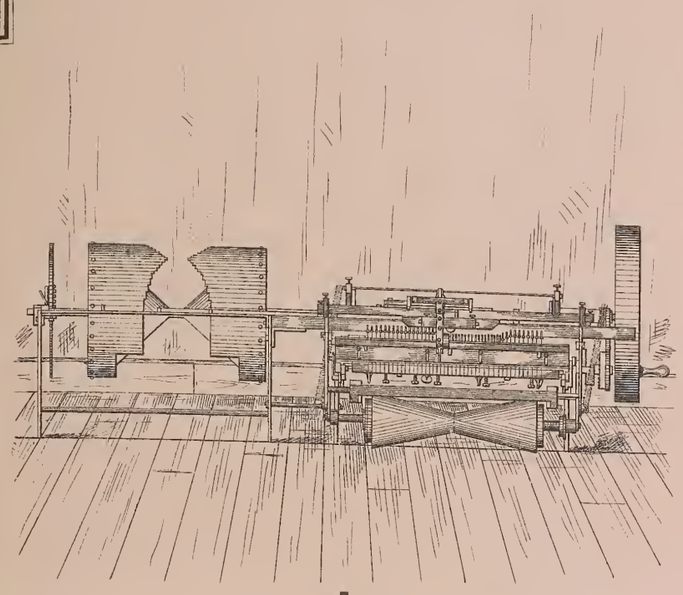
The progress made in this branch of manufacture is astonishing, as the United States now make almost all the undergoods, stockings, hosiery, scarfs, neck comforts, opera hoods, &c., which they consume, amounting to about forty million dollars annually. Not only are the goods woven circular, but within ten or fifteen years the manufacturers have succeeded in making goods which are fitted to the form, and in making them, not by hand, but by machinery, and surpassing in quality the goods made abroad.

American wool, with its long, glossy staple, is well fitted to the production of this class of fabrics, and American competition has not only succeeded in taking possession of the home market for American products, but in greatly reducing prices.

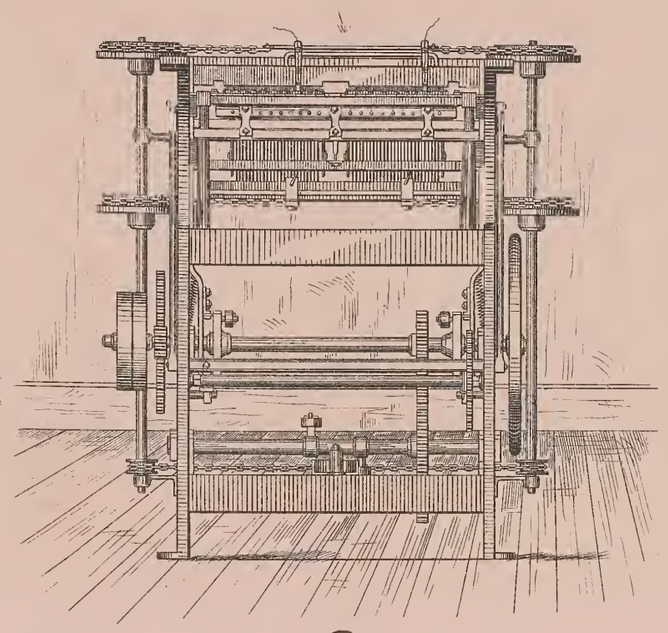
KNITTING---CIRCULAR MACHINES.

276 Patents Granted by the United States.

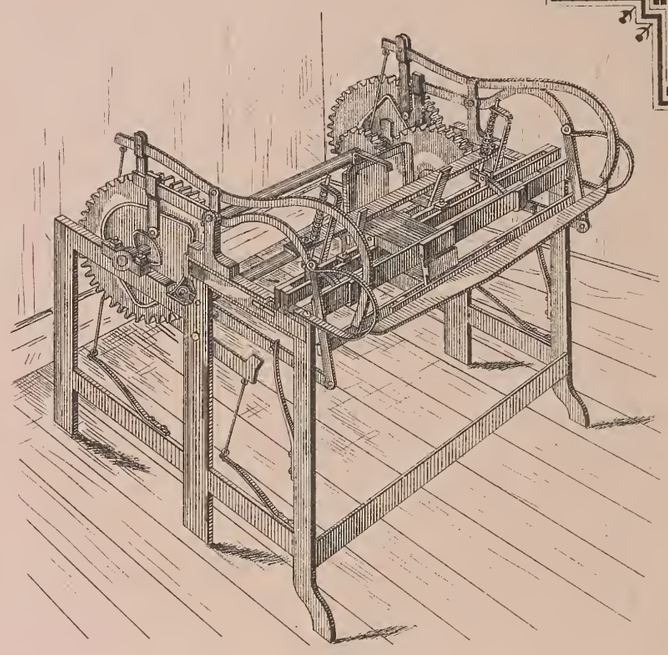
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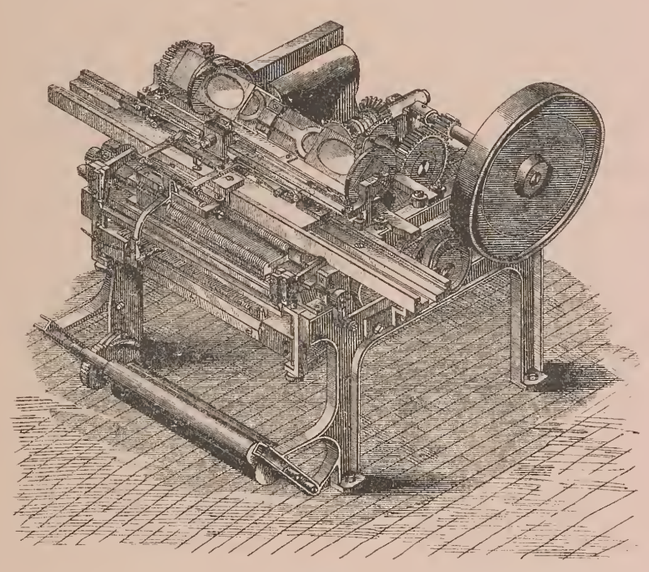
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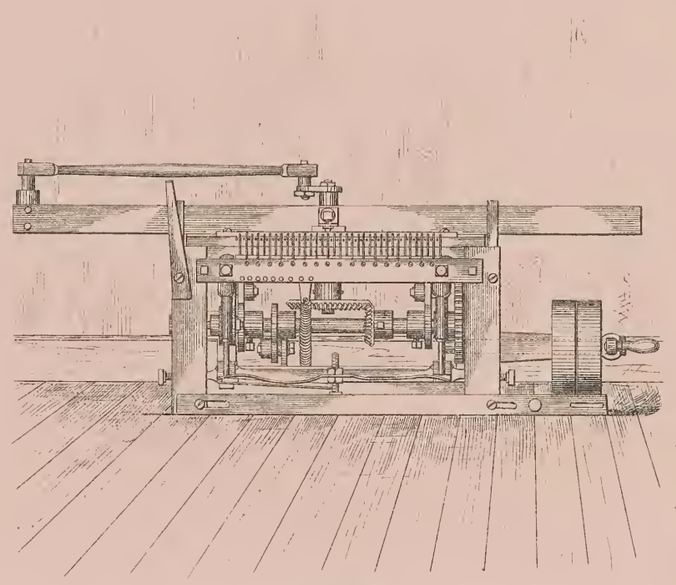
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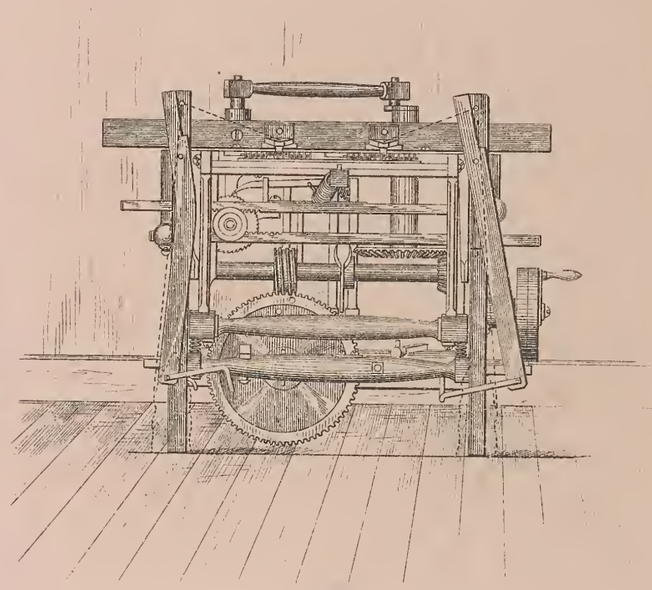
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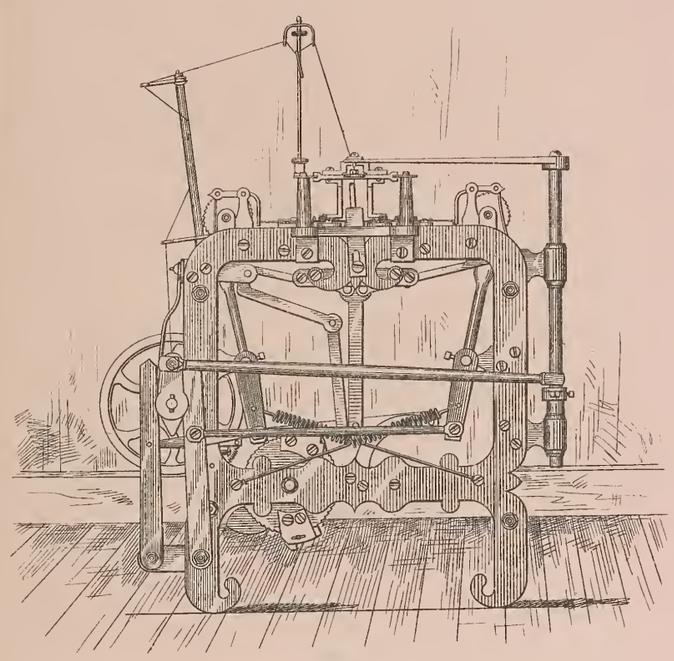
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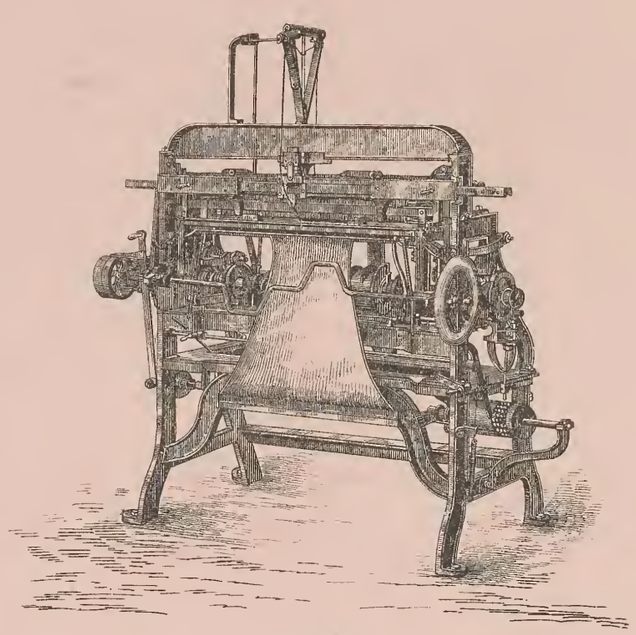
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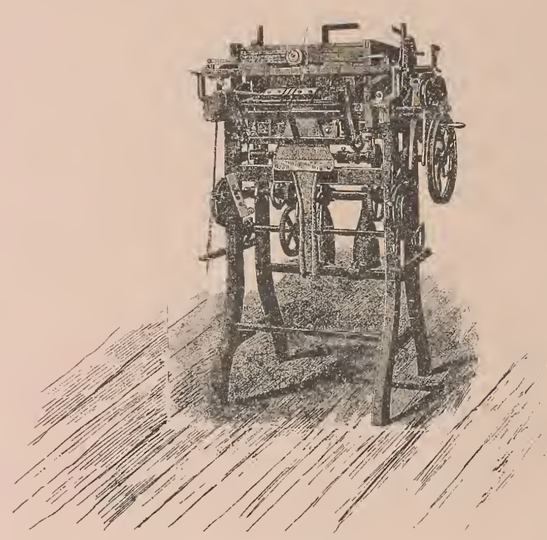
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9

KNITTING--STRAIGHT MACHINES.

KNITTING---STRAIGHT MACHINES.

No. 1. U. S. Patent, Knitting Fashion Fabrics—A. D. 1843.
2. " " " two separate fabrics at same time—A. D. 1851.
3. " " " Plain Work—A. D. 1858.
4. " " " Fashioned Work—A. D. 1854.
5. " " " Ribbed and Plain Work—A. D. 1855.
6. " " " Fashioned Work—A. D. 1856.
7. " " " Irregular Tubular \ \. D. 1867.
8. " " " Fashioned Work—A. D. 1878.
9. " " " Stockings, Full, Regular Make—A. D. 1884.

Machine knitting was invented in 1589 by an English clergyman named Wm. Lee, who was refused a patent by Queen Elizabeth on the ground that it would take away the occupation of a large number of her subjects. Lee went to France where he set up his stocking frames, but he failed to make any money, and died in 1610, it is said, poor, of a broken heart. Lee's machine consisted of a series of hooked or bearded wires or needles having slotted or grooved shanks into which the point of the hook or beard was pressed, and these needles were arranged at regular intervals in a row on a bar, the thread or yarn being manipulated thereon to produce knitting very much as now done on flat frames.

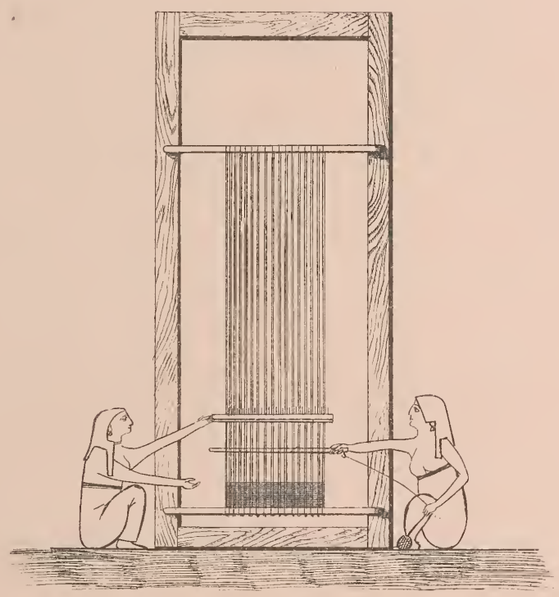
After Lee's death the workmen whom he had taken to France returned to England with the machine and succeeded in introducing its use in London. Soon afterwards the manufacturers of stockings by the "stocking frame," as the machine was called, was introduced into Nottinghamshire which soon acquired the reputation it has since retained for this industry.

There have been various improvements introduced into this branch of manufacture until the number of stocking frames in England has increased to over 50,000, giving employment in Nottinghamshire alone to about 40,000 persons.

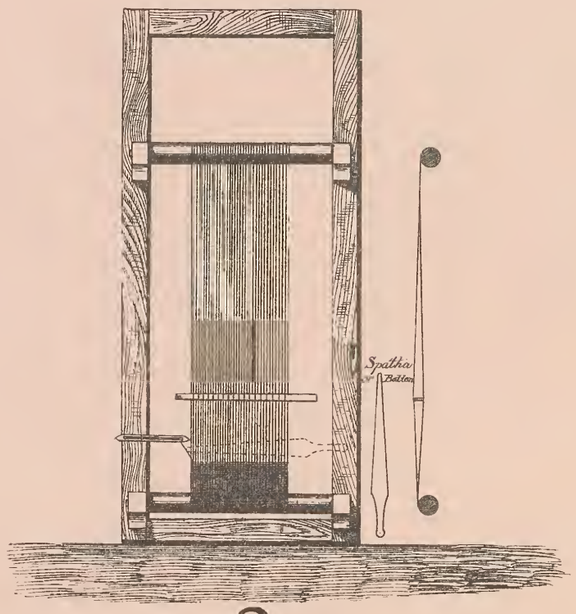
KNITTING---STRAIGHT MACHINES.

201 Patents Granted by the United States.

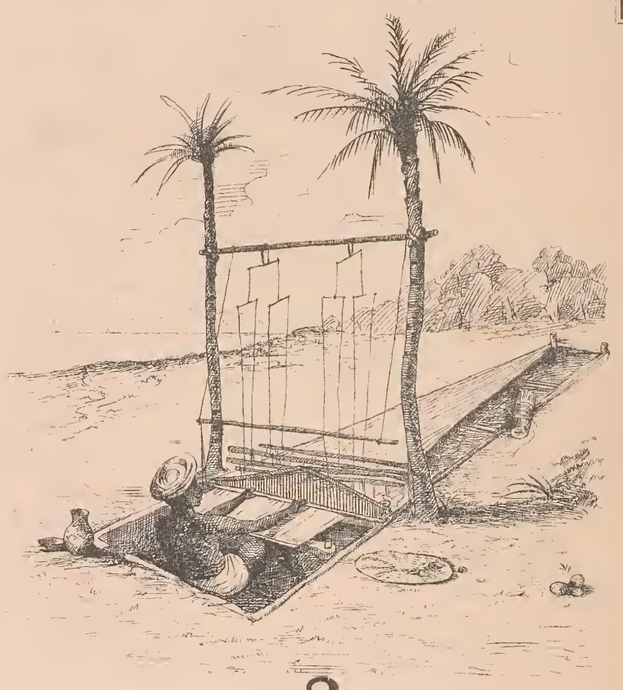
Sackett & Wilhelms Litho Co New York



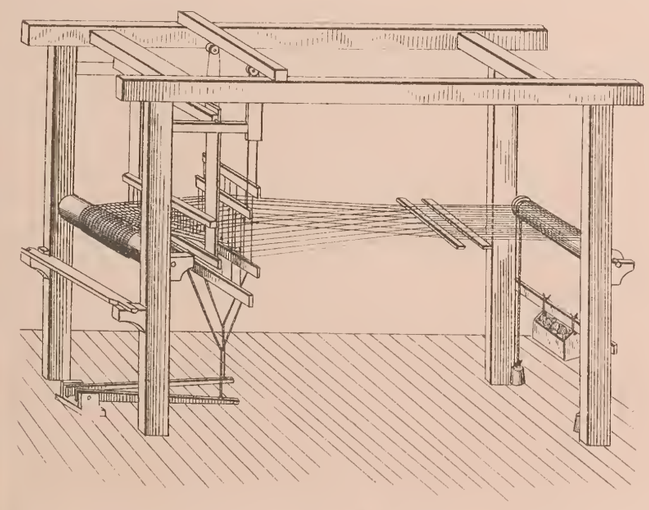
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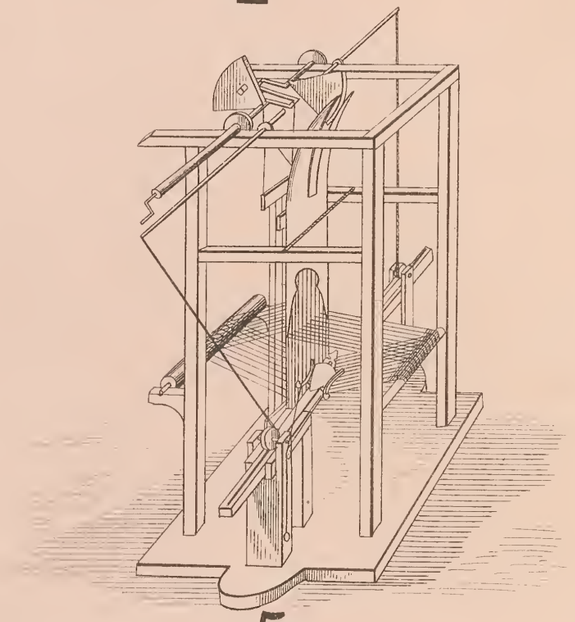
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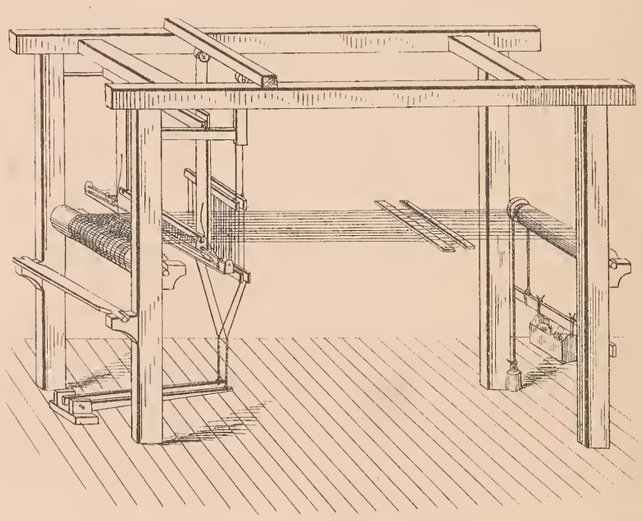
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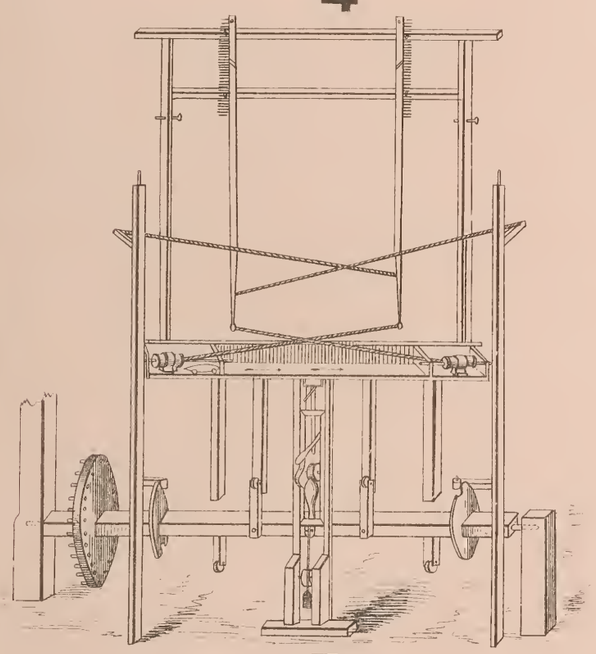
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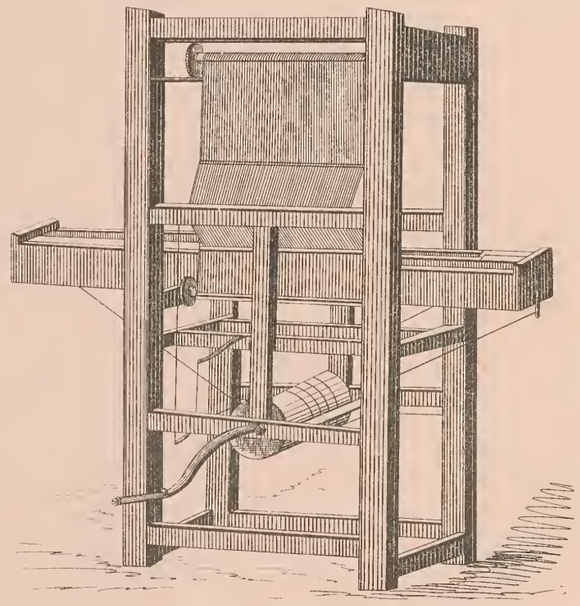
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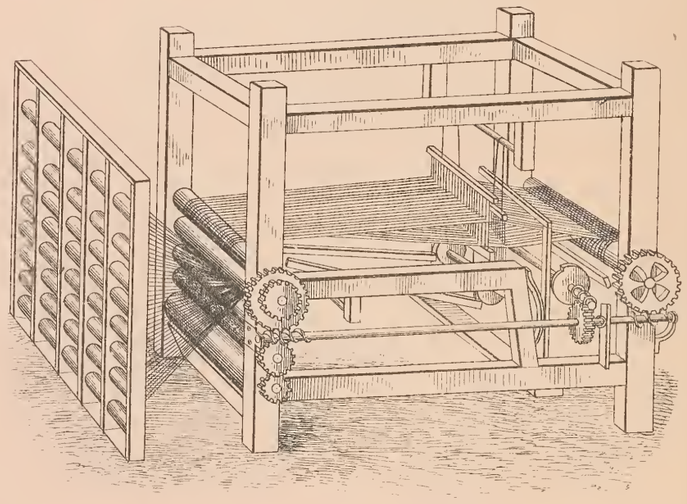
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9

LOOMS FOR WEAVING.

LOOMS FOR WEAVING.

No. 1. Primitive Egyptian.
2. " Roman.
3. " Hindoo.
4. " Hand.
5. Power Loom—A. D. 1678.
6. Fly Shuttle Hand Loom—A. D. 1733.
7. English Power Loom—A. D. 1774.
8. " " " —A. D. 1785.
9. Power Loom—A. D. 1786.

The invention of the loom, or an instrument by which a continuous fabric is woven from threads, is lost in the obscurity of the pre-historic period, and was probably one of the first inventions made by mankind. On the tombs at Thebes, and on the remains of Egyptian architecture, looms of simple construction are to be seen, and the cloths found upon the mummies of ancient Egypt show, from the fineness and regularity of their texture, that the Egyptians had the art of doing better weaving than it would be supposed possible from the apparently imperfect looms represented.

The simplest and probably the most ancient of looms is that of the Hindoo Tanty, and yet some of the fabrics from the looms of India are unrivaled for their delicacy of texture.

The use of the loom in Europe was introduced in the early ages of the Christian era. Italy and the Netherlands were for a time the countries most distinguished for their skill in its use.

The earliest association of persons in England for the promotion of a particular branch of trade, and sanctioned by the authority of the Government, was that of the company of weavers in the reign of Henry II, in 1170.

Edward III appears to have been the first British monarch to encourage and foster textile manufacturers by inviting Flemish workmen to go to England and establish themselves under his protection.

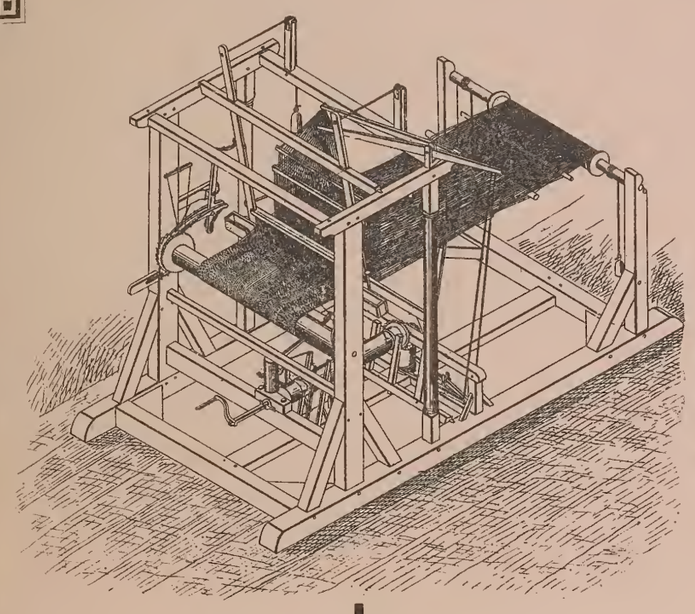
Cotton fabrics which were unknown in Europe were sent in 1519, by Cortez, from Mexico to Spain, and in the same year Magellan, when circumnavigating the world, found Brazilians using cotton, which he called vegetable down.

In the perfected loom of to-day the shuttle is thrown 180 times a minute, or three times a second.

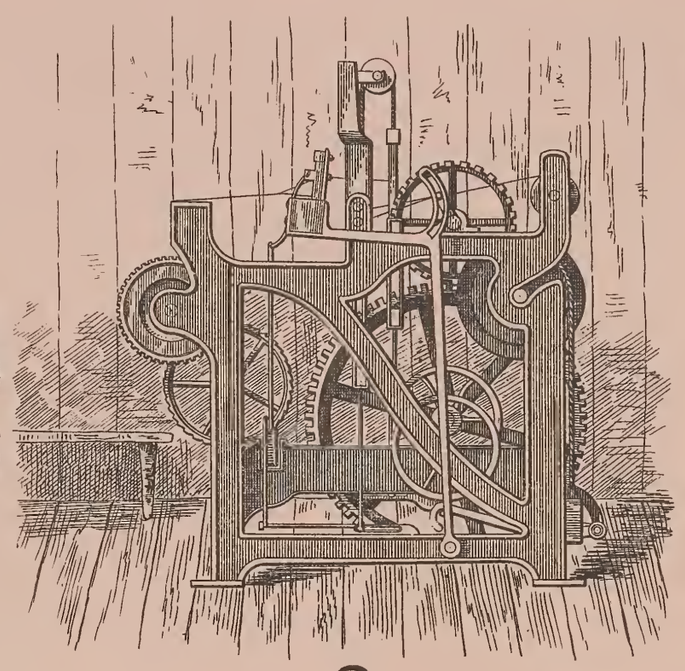
LOOMS FOR WEAVING.

2,128 Patents Granted by the United States.

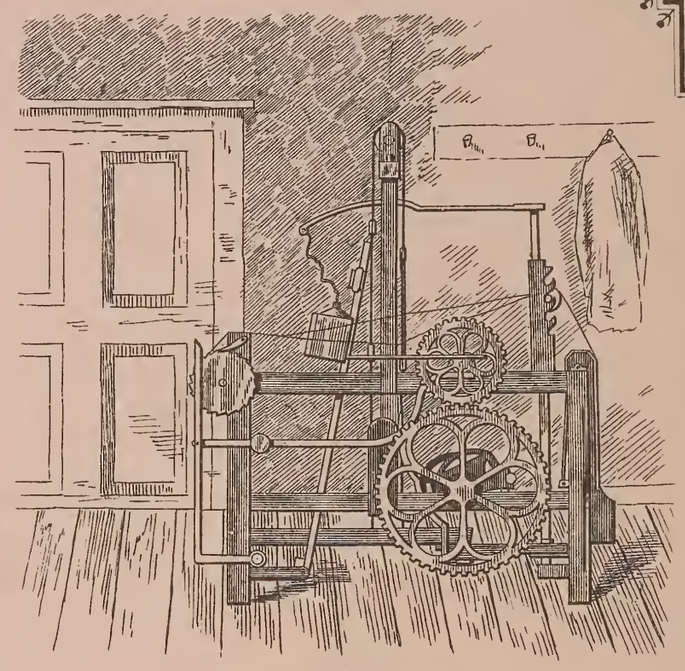
Sackett & Wilhelms Litho Co New York



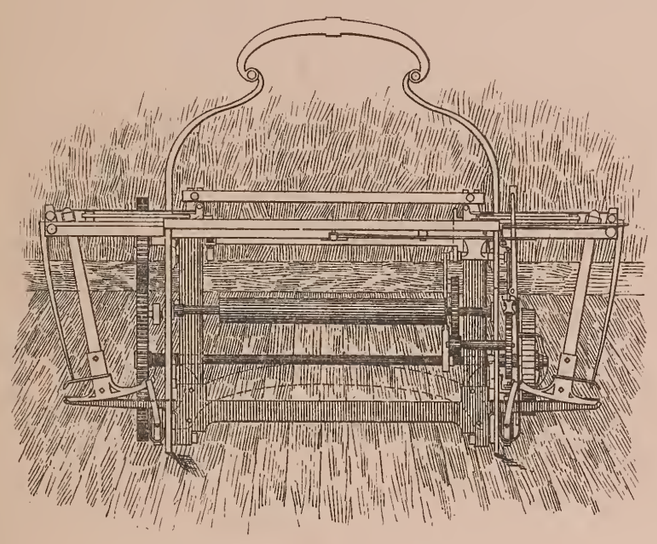
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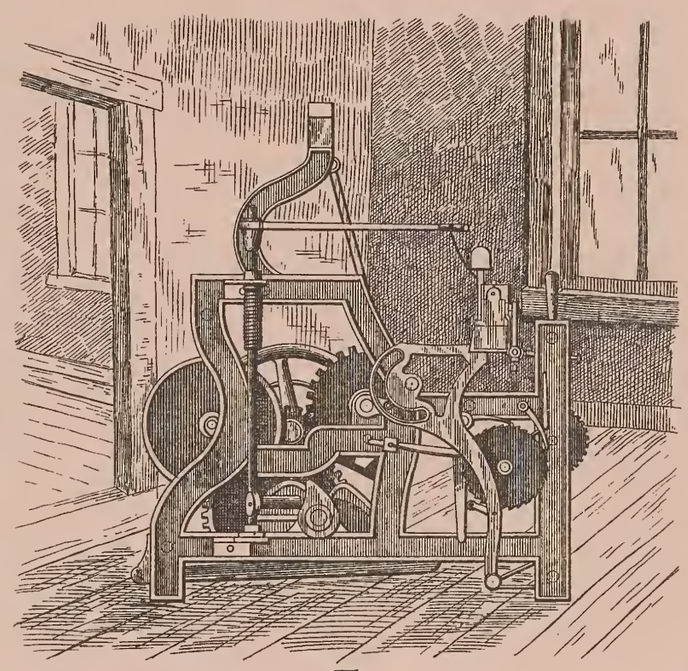
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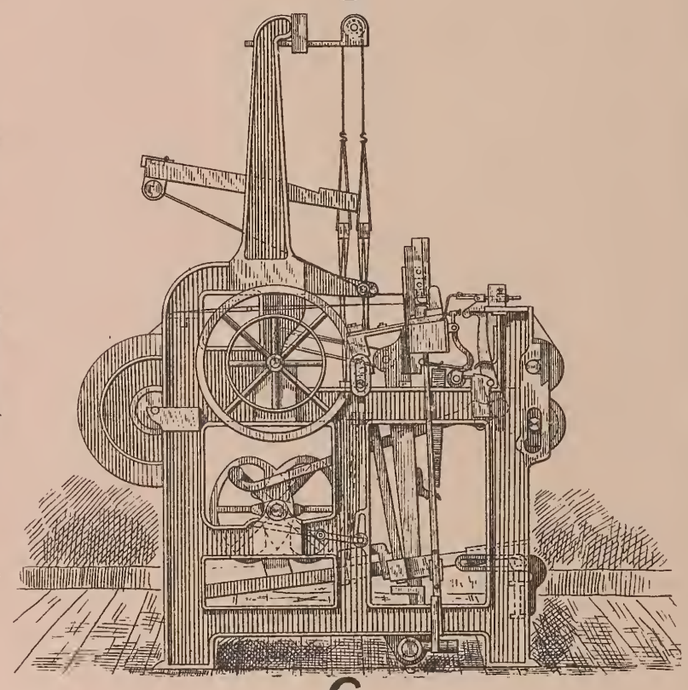
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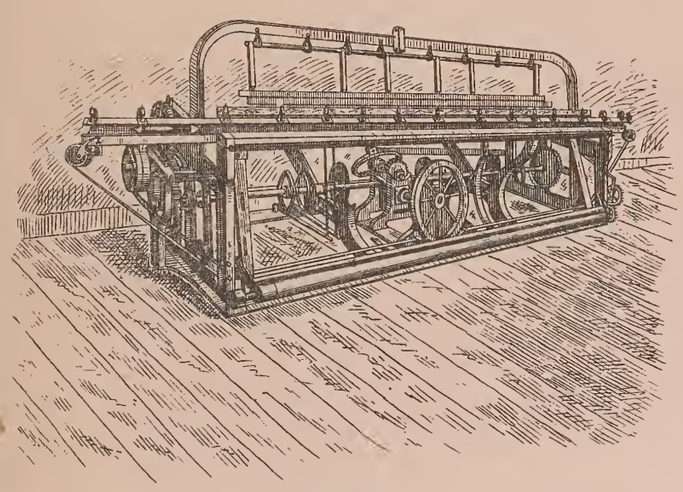
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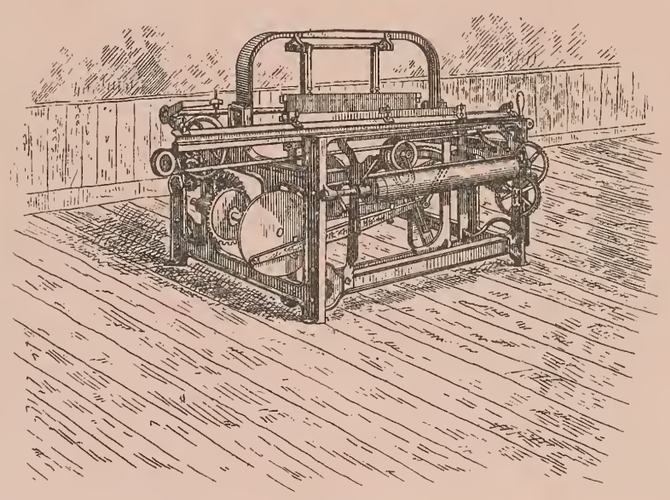
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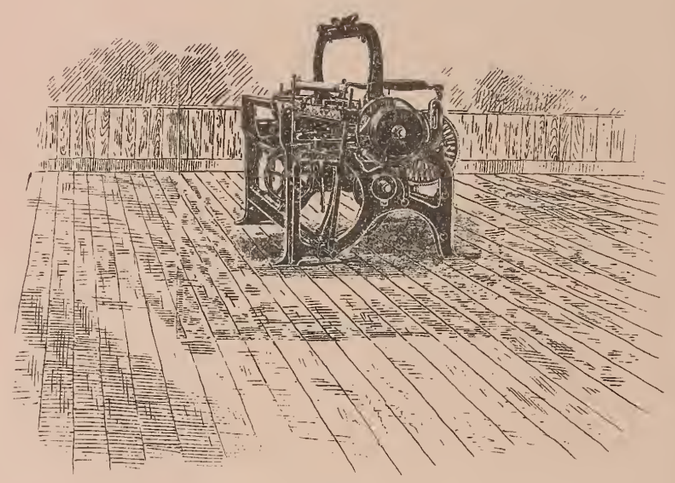
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9

LOOM POWER FOR WEAVING PLAIN FABRICS.

LOOM POWER FOR WEAVING PLAIN FABRICS.

No. 1. U. S. Patent, Plain Loom—A. D. 1810.
2. " " " " Weaving Broadcloth—A. D. 1830.
3. " " " " —A. D. 1842.
4. " " " " —A. D. 1852.
5. " " " " —A. D. 1868.
6. " " Continuous Weft Loom—A. D. 1870.
7. " " Positive Motion Loom for Oilcloth.
8. " " " " " " Narrow Sheeting.
9. " " Plain Loom.

The power loom, that is a loom actuated by machinery in contradistinction to a hand loom, was invented by Dr. Cartwright in 1785. He was a clergyman, and belonged in the county of Nottingham, England.

Previous to this the fly-shuttle had been invented by John Kay, of Lancaster Co., England, who patented his invention May 26, 1733. This superseded the old way of throwing the shuttle by hand, and enabled one weaver to do the work of two or three.

There was great opposition to Cartwright's invention, and the operatives burned a mill containing five hundred of his looms. Steam was applied to his loom in 1806, and in 1809 he received from Parliament a gift of £10,000 for his invention.

The first factory in America, if not in the world, where a power loom was used and spinning and weaving were carried on under the same roof, was erected at Waltham, Mass., in 1813, and as early as 1831 it is estimated that there were 33,433 looms in use in the United States.

The first carpets woven by a power loom in this or any other country were produced in 1839 at Lowell, Mass. In that year Erastus B. Bigelow invented his power loom for weaving ingrain carpets. This machine could easily weave from 25 to 27 yards per day, whereas the previous hand loom production never exceeded eight yards.

This invention was followed later by a power loom for brussels and tapestry carpets, one of the most ingenious pieces of mechanism ever devised.

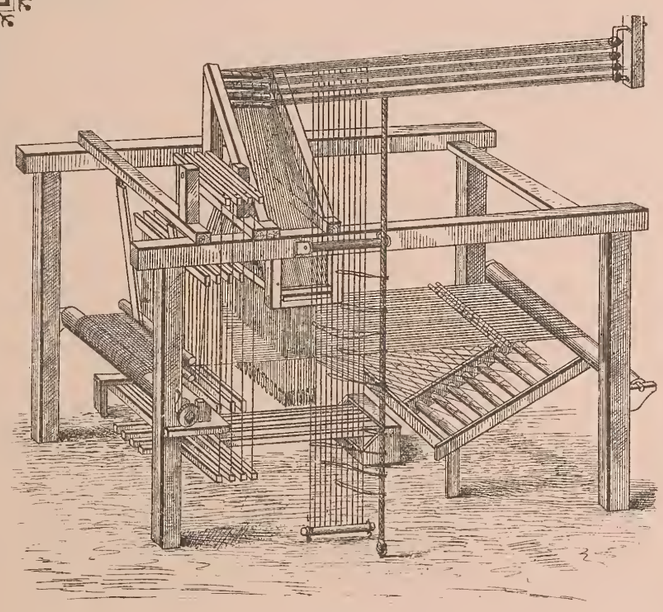
The growth of the weaving industry from that time to the present is exemplified in most of our large mills and factories, where looms constructed half a century ago are kept merely to show by way of contrast the wonderful progress that has been made in the art of weaving during the present generation.

In the perfected loom of to-day the shuttle is thrown three times a second, or 180 times a minute.

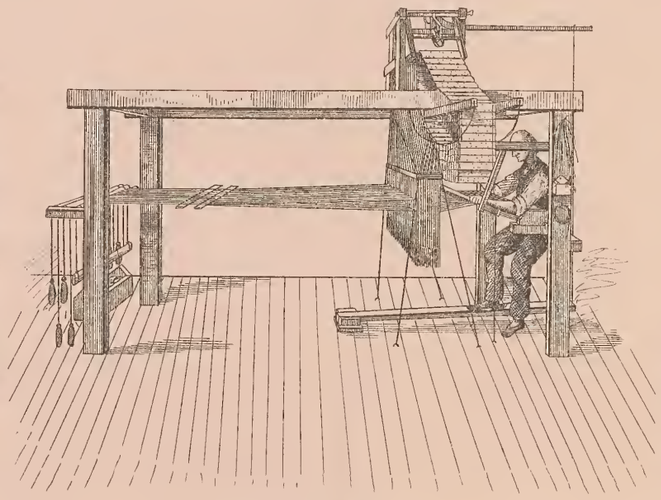
LOOM POWER FOR WEAVING PLAIN FABRICS.

2,128 Patents Granted by the United States.

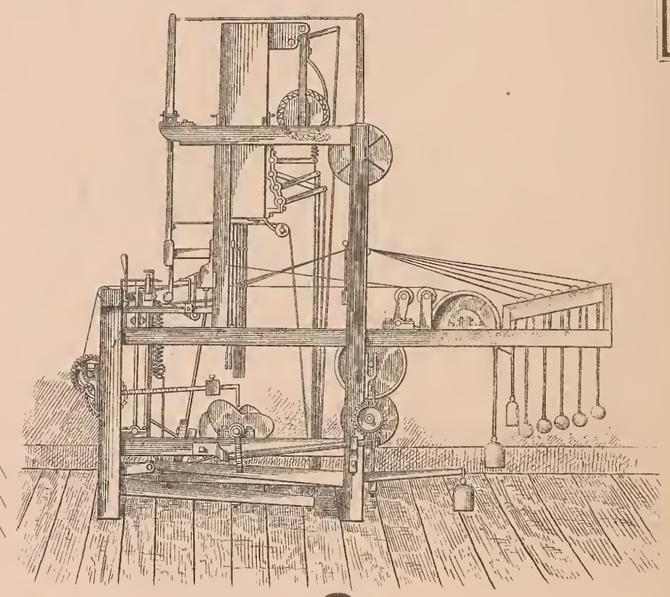
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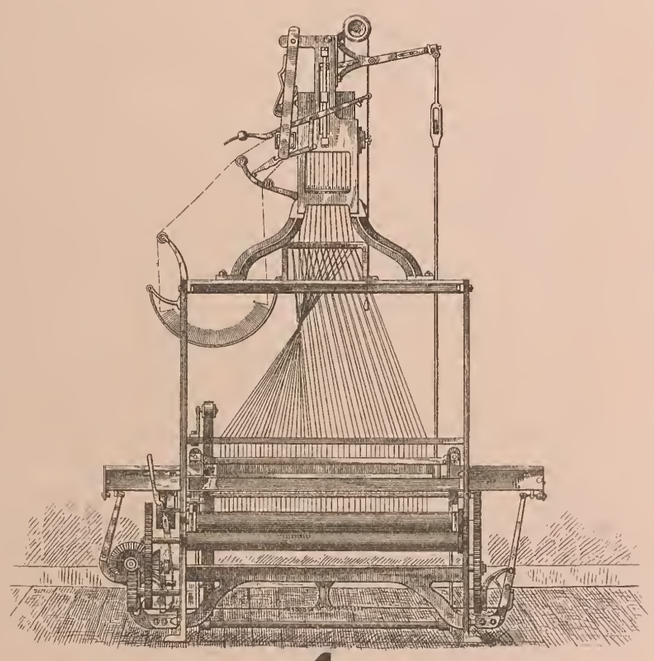
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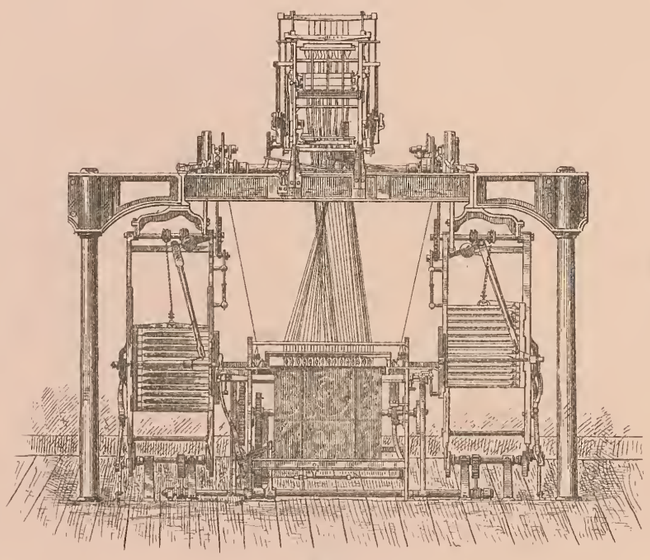
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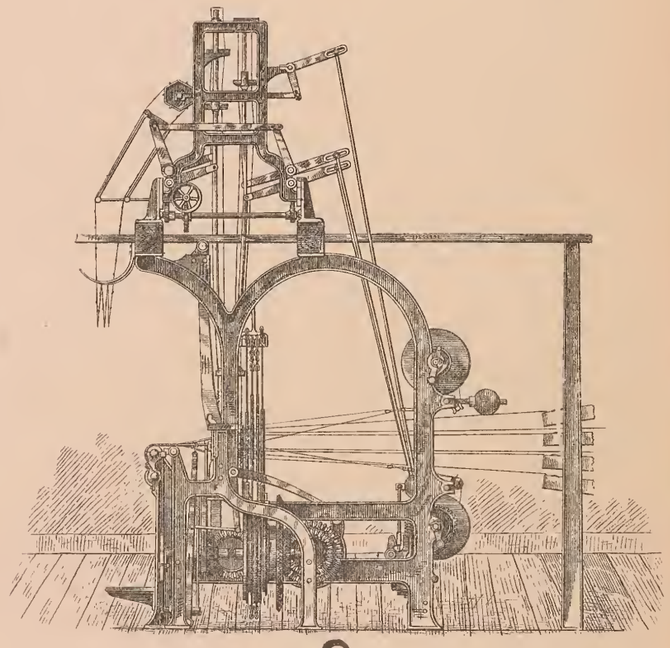
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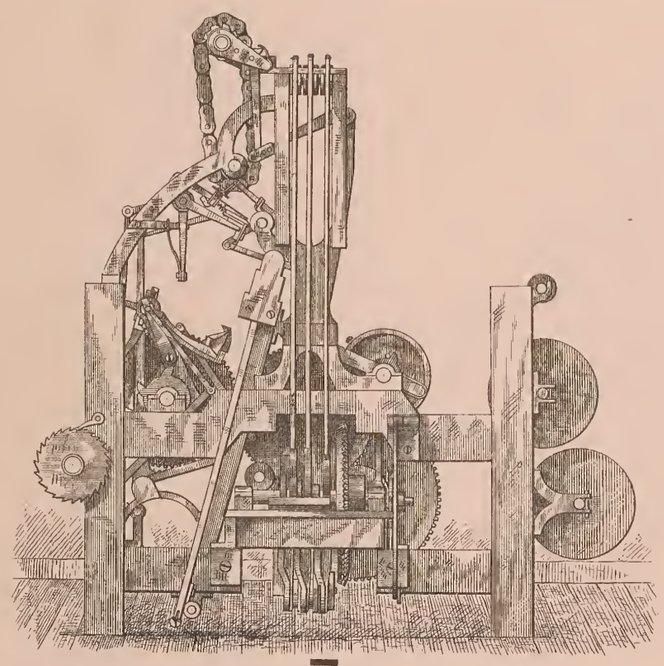
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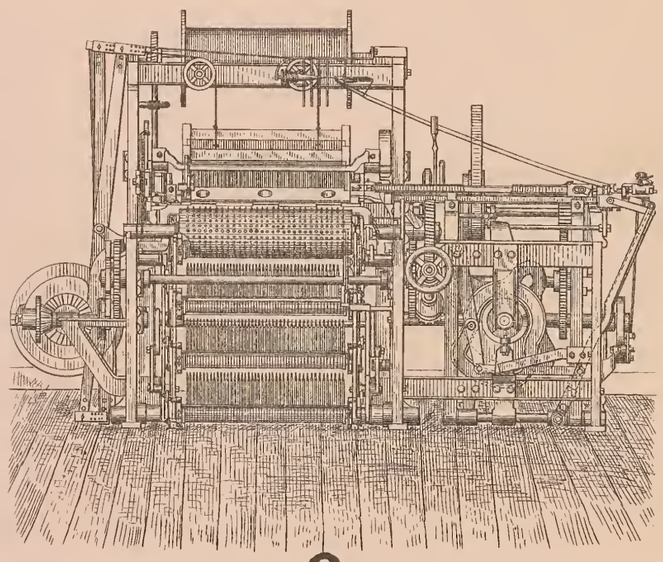
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LOOMS--JACQUARD AND MOQUETTE.

LOOMS---JACQUARD AND MOQUETTE.

Nu. 1. Primitive Draw Boy.
2. " Jacquard.
3. U. S. Patent, Power Pile Wires—A. D. 1837.
4. " " Jacquard—A. D. 1842.
5. " " Power for Weaving Ingrain Carpet—A. D. 1849.
6. " " " " Double Pile Fabrics—1851.
7. " " Moquette—A. D. 1856.
8. " " " —A. D. 1881.

The Jacquard loom was invented by Jacquard, a straw hat manufacturer at Lyons, and his invention produced a complete revolution in the art of figure weaving. His incentive was a prize offered for the production of a machine for making nets.

Napoleon's attention was called to his wonderful inventive genius, and he was asked if he could not improve on a loom belonging to the French Government, which was designed for weaving shawl patterns in imitation of cashmere, which was very expensive.

Jacquard improved on the model of Van Causer, produced the machine which bears his name, and was awarded a pension of 6,000 francs.

He was also awarded a bronze medal at the French exposition in 1801.

His invention excited great opposition at first from the weavers at Lyons.

Jacquard died in 1834, and he was one of the few inventors who reaped a pecuniary reward from the product of his genius, for besides his pension he received a royalty of 50 francs on each machine sold.

Draper, in 1834, 1835, and 1837, took out patents for Jacquard application to the lace frame. He was the earliest and most ingenious, though not most successful, pioneer in finding out how every thread in a machine might be as simply and perfectly controlled as those on a pillow by the fingers of a workman. Money failed before Draper had quite accomplished this; but his diversified combinations of lace machinery were the real germs of those which have been perfected by his successors, with great profit to themselves and to the establishment of the trade; yet this clever mechanic fell into deep and unassisted poverty.

By 1840 the application of the Jacquard to the lace machine had been effected.

Oldknow, in 1849, added the use of very thin steel bars, pierced so as to pass warp threads through them, and guiding the movement of each sideways right and left. Articles are thus made from the narrowest braid to a highly-figured lace curtain two yards wide, and requiring ten or twelve thousand cords to produce the pattern. Oldknow granted 1,170 licenses, and now 3,000 machines are using his perforated steel-bar invention.

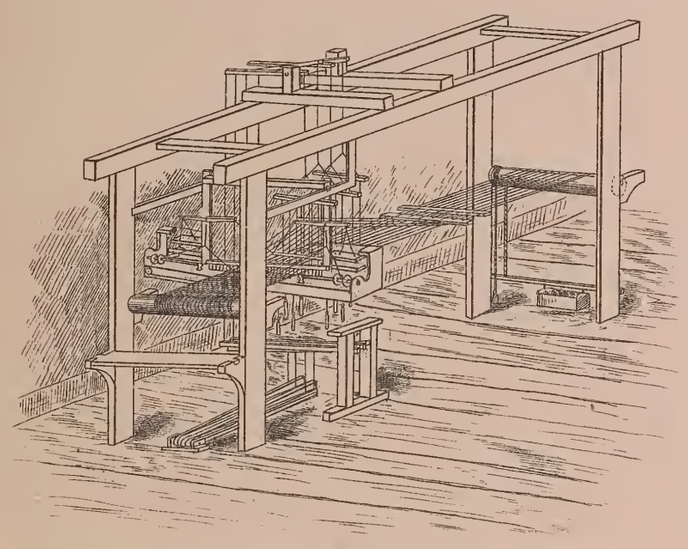
The complex operations governed from the ends and backs of Levers' machines are carried on in a small space, but through their whole width of perhaps two hundred inches, safely and exactly, prompt attention being given to remedy any defects in materials or workmanship.

In 1841 Deverill had patented a claim to the first successful application of the Jacquard to the end of a lace frame. Birkin bought the invention from Deverill; but, seeing a doubt arise, relinquished his supposed right, and with most praiseworthy spirit thus restored freedom of action to the fancy lace department, in which direction alone general profit was to be hoped for.

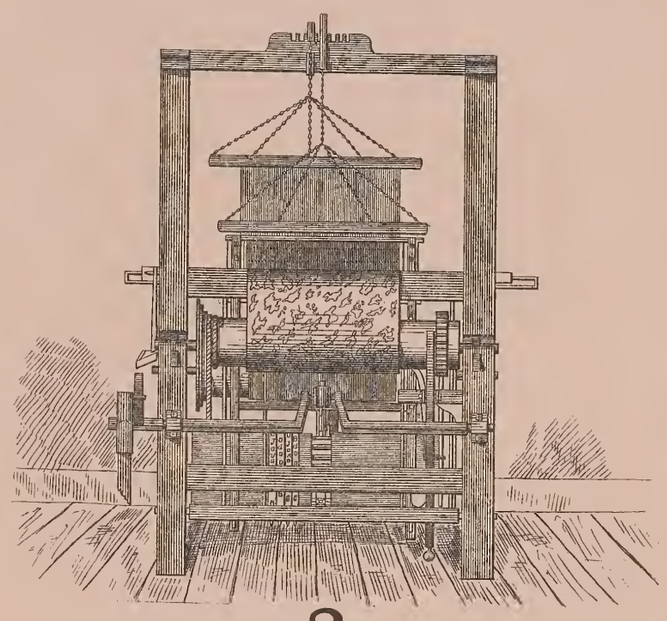
LOOMS---JACQUARD AND MOQUETTE.

2,128 Patents Granted by the United States.

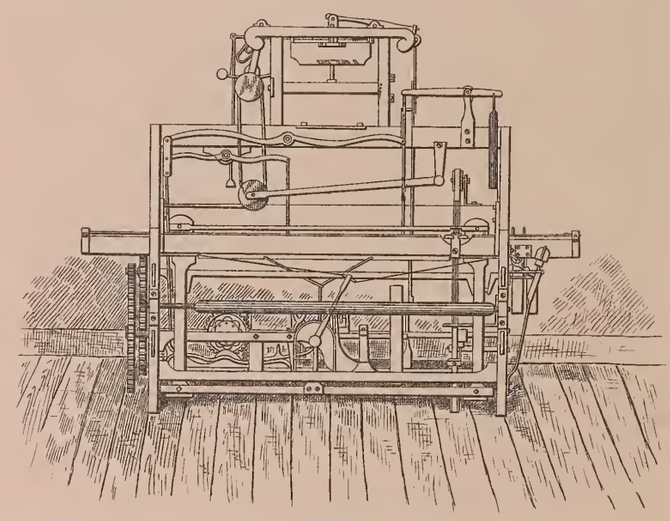
Sackett & Wilhelms Litho Co New York



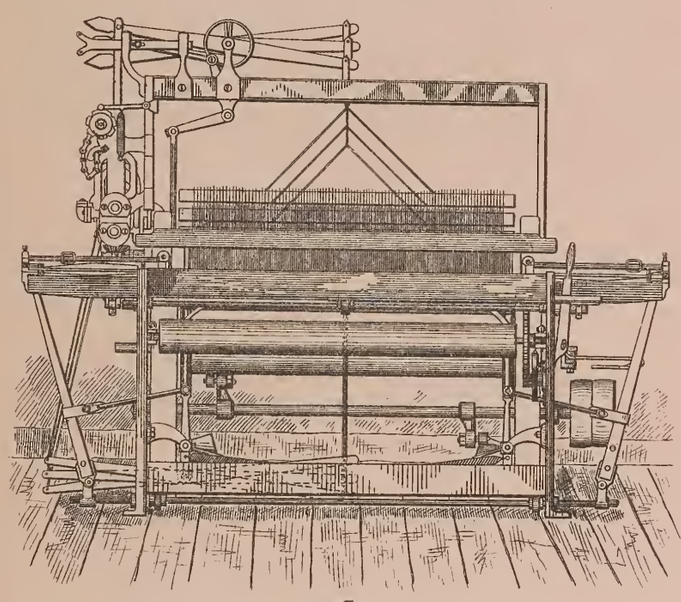
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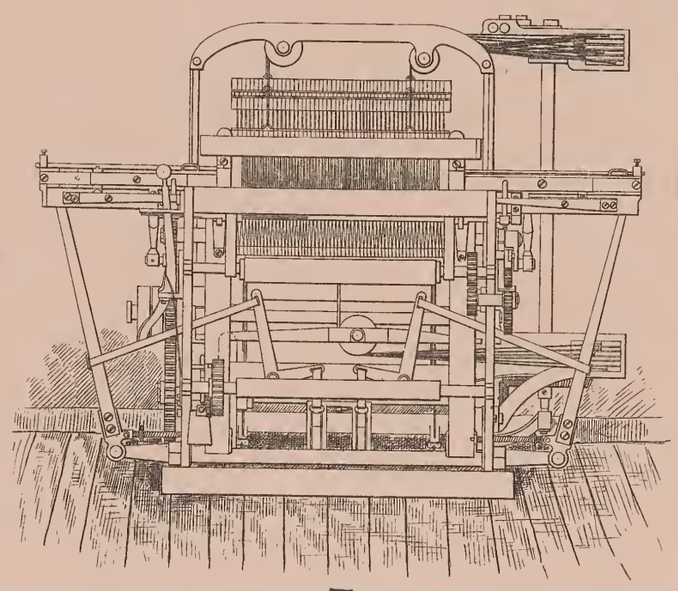
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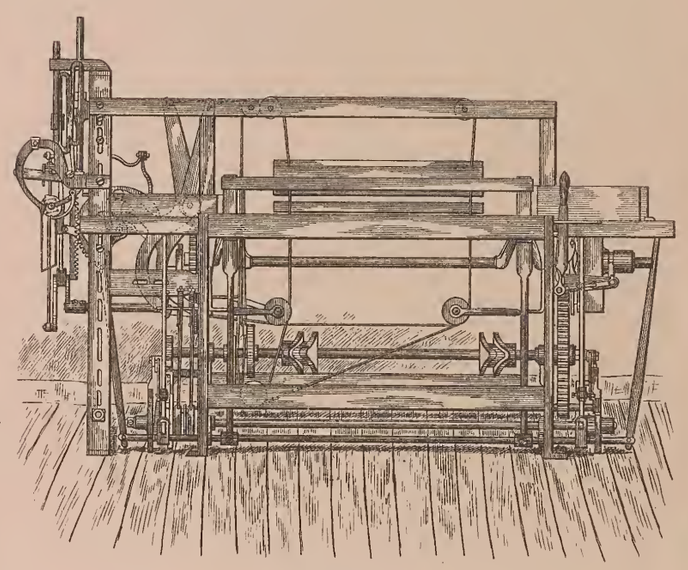
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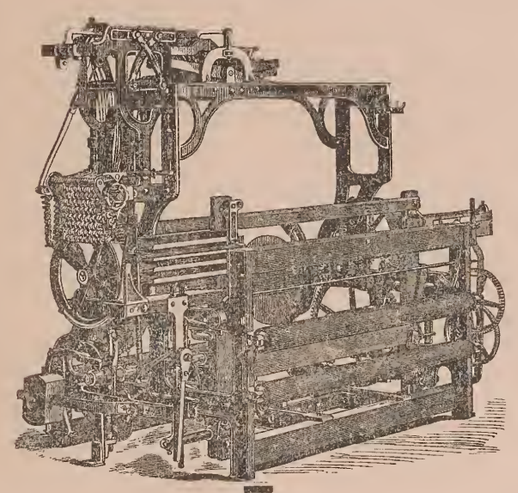
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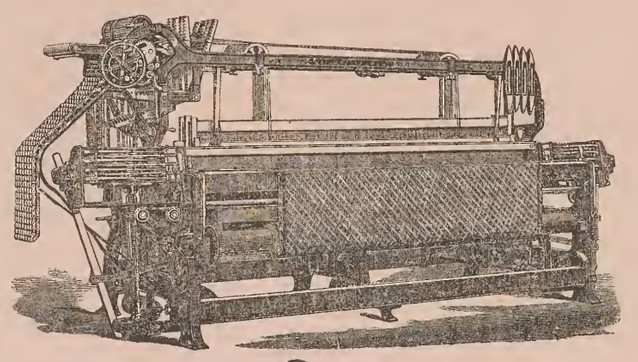
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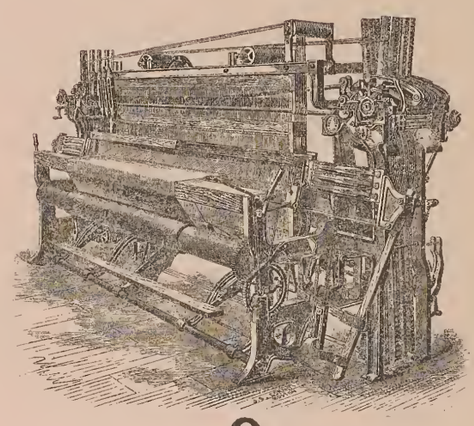
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9

LOOMS FOR FANCY WEAVING.

LOOMS FOR FANCY WEAVING.

No. 1. Drop Box Movable Shuttle Boxes—A. D. 1760.
2. U. S. Patent, Weaving Figured Goods—A. D. 1812.
3. " " Fancy Loom—A. D. 1843.
4. " " " " —A. D. 1849.
5. " " Weaving Venetian Carpeting—A. D. 1850.
6. " " Fancy Loom—A. D. 1855.
7. " " Open Shed Loom—A. D. 1884.
8. " " Open Shed Broad Loom—A. D. 1884.
9. " " Broad Loom for Fancy Cassimere—A. D. 1884.

The term "fancy loom" is used to designate such looms as produce figures in the weaving.

The fancy loom, which is known and used in all countries, was invented by Wm. Compton, of Worcester, Mass., in 1836, and was patented the following year.

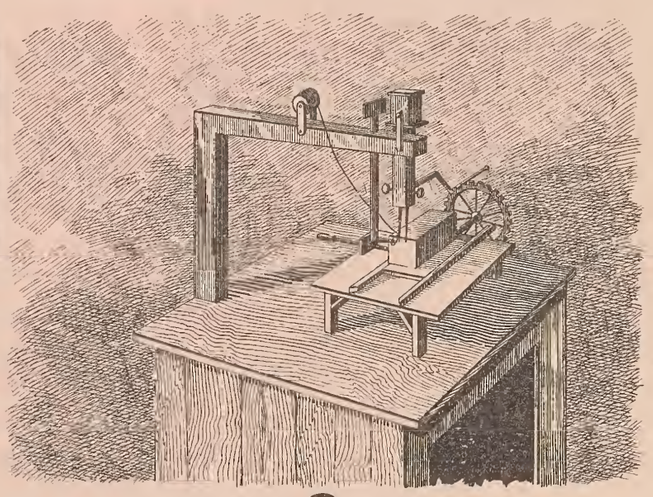
LOOMS FOR FANCY WEAVING.

2,128 Patents Granted by the United States.

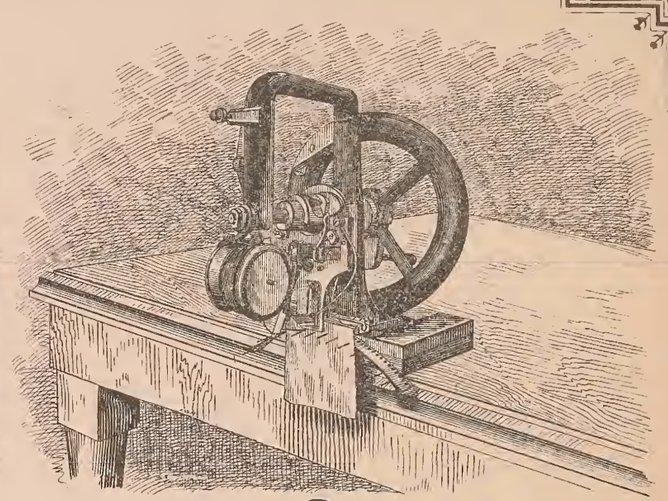
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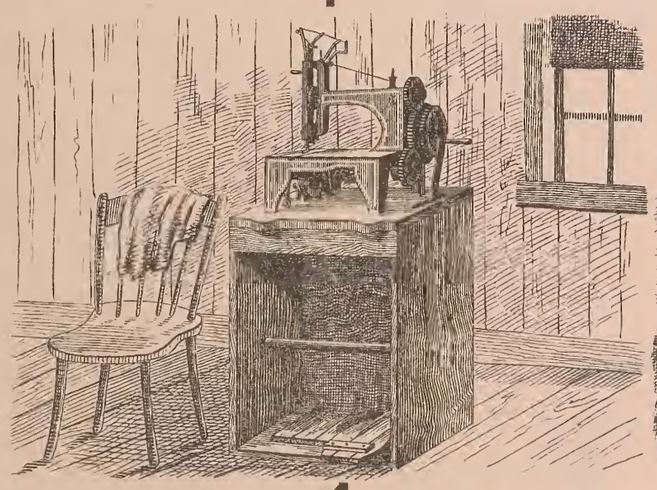
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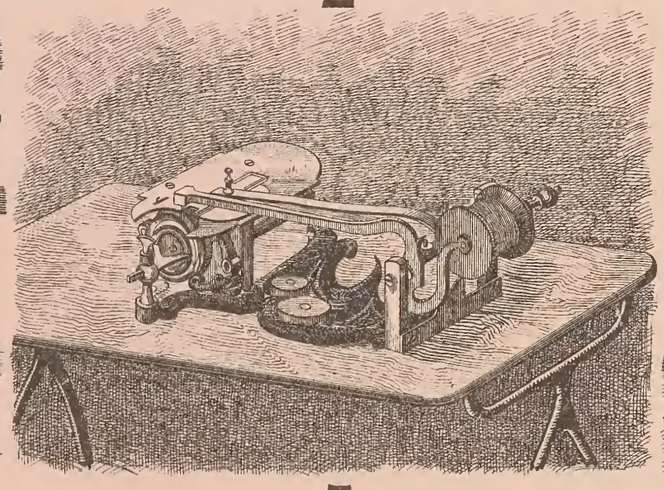
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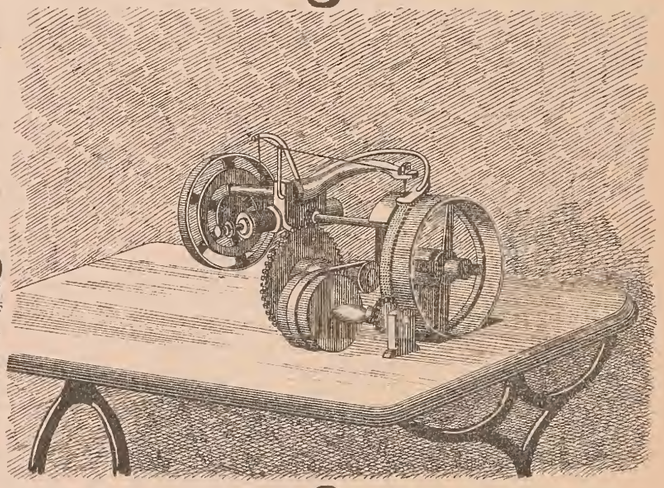
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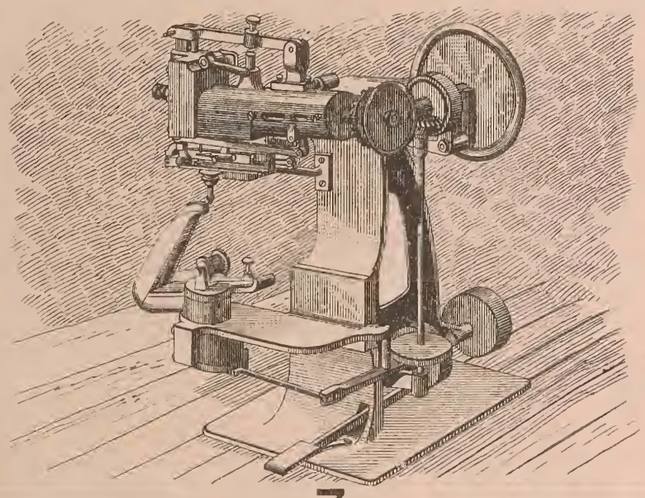
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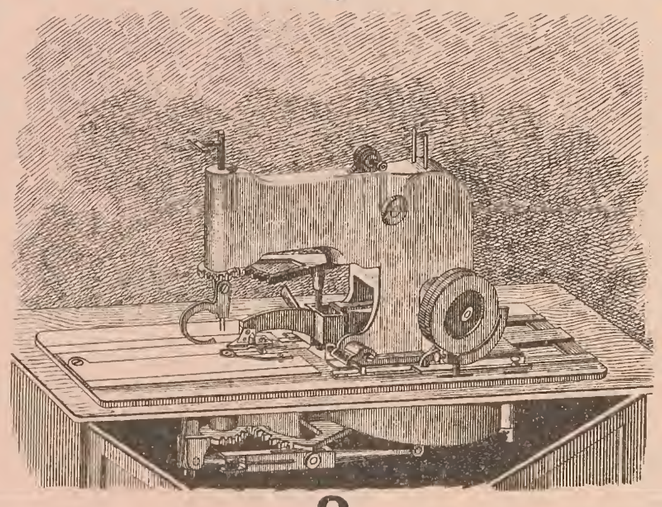
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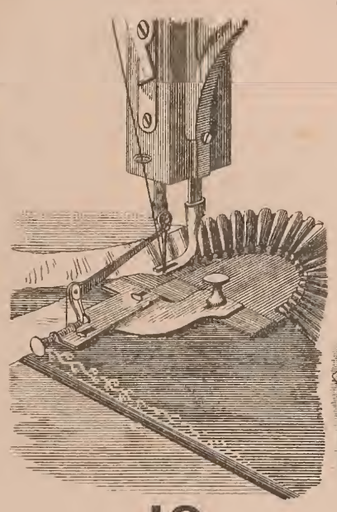
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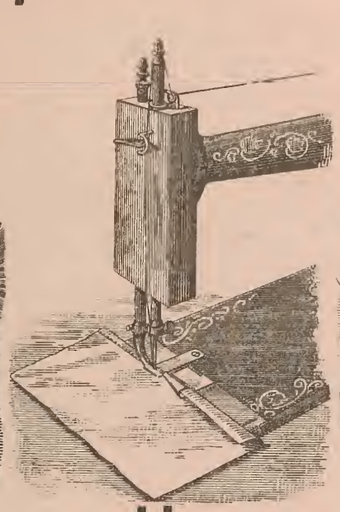
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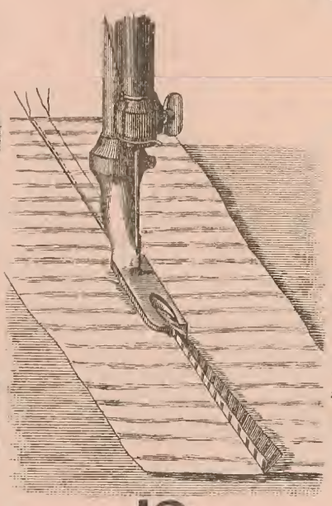
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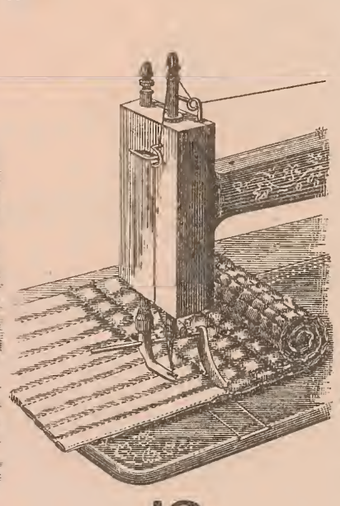
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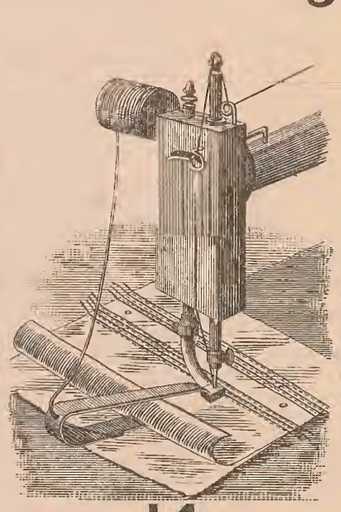
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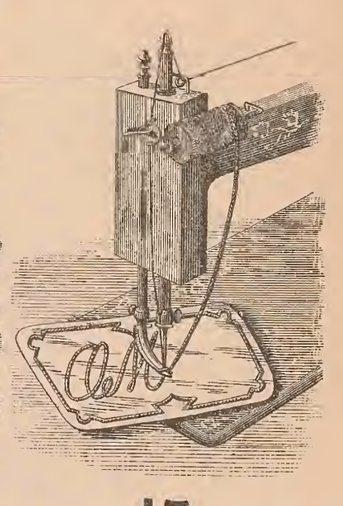
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15

SEWING MACHINES AND ATTACHMENTS.

SEWING MACHINES AND ATTACHMENTS.

No. 1. Primitive Hand Sewing.
2. English Chain Stitch—A. D. 1790.
3. U. S. Patent, Lock Stitch—A. D. 1846.
4. " " " " —A. D. 1851.
5. " " Four Motion Feed—A. D. 1852.
6. " " Chain Stitch—A. D. 1857.
7. " " Boot and Shoe—A. D 1875.
8. " " Button Hole—A. D. 1881.
9. Machine Sewing—A. D. 1884.
10. Gatherer or Ruffler—A. D. 1884.
11. Plate Hemmer and Binder—A. D. 1884.
12. Feller—A. D. 1884.
13. Quilter—A. D. 1884.
14. Corder—A. D. 1884.
15. Braider—A. D. 1884.

The first attempts of a mechanical contrivance for reducing the labor of sewing, as was natural, were rather close imitations of hand sewing, though they introduced features essential to the most improved sewing machines. The ancient tambourine apparatus for embroidering figures upon fabrics, to be afterwards removed and sewed upon others, combined the eye pointed needle with other devices now common in sewing machines.

The earliest patent on sewing machines appears to have been granted in England to C. F. Weisenthal, June 24, 1755. His patent was for the needle with the eye in the center and pointed at both ends. The device was operated by hand.

Saint's machine (English patent of July, 1790,) is the nearest approach to the modern apparatus, but was adapted only to leather sewing, as the notched needle which pushed the thread through could not have been used for fibrous material.

In 1825, Thimmonnier, a poor tailor of France, conceived the idea of a sewing apparatus, and for sixteen years labored to develop it. In 1834 he obtained a patent for a crocheting machine adapted to sewing purposes. He achieved substantial success, and in 1841 two hundred of his machines were at work making army clothing.

A machine was patented February 21, 1842, in the United States, by J. J. Greenough, for making the through and through stitch, having a double pointed needle with an eye in the middle, which was drawn through the cloth by pincers.

Benjamin W. Bean in 1843, patented a machine for making a running or basting stitch, the needle passing through the corrugations of the cloth.

In 1845, Elias Howe, of Cambridge, Mass., completed his first machine and obtained a patent thereon September 10, 1846. This was the first complete sewing machine designed for general purposes.

His principle covered the forming of the seam "by carrying a thread through the cloth by means of a curved needle on the end of a vibrating arm, and the passing of a shuttle furnished with its bobbin between the needle and the thread which it carried."

Mr. Howe, almost immediately after obtaining his patent, went to Europe to obtain capital for the manufacture of his machine, but he was met by a scepticism even more obdurate and discouraging than he encountered from those to whom he applied for aid in the United States. He returned home after two years, in a sailing vessel, paying for his passage by manual labor, and arriving literally penniless.

Singer's first patent was granted in 1851.

The first rotating hook was patented by Wilson in 1851.

Gibbs invented the rotating hook which produces a twist in the looping stitch.

Wilcox invented the automatic tension.

The Grover & Baker machine of 1852 first introduced the double loop stitch employing two threads effected by a circular horizontally moving needle.

The vibratory eye-pointed needle, the reciprocating shuttle, the rotating hook and the four-motion feed, are the essential foundation elements of sewing machines.

Sewing machine attachments are classified as follows: Binders, holders, bobbin winders, braiders, corders, guides, hemmers, needle clamps, presser feet and lifters, rufflers and gatherers, setters and threaders, take ups, tensions, needles, shuttles, bobbins, thread cutters, trimmers, tuck creasers, markers, tucking guides, &c.

SEWING MACHINES AND ATTACHMENTS.

106 Manufactories in the United States.

	1860	1880
Capital Invested,	$1,427,750.00	$12,501,830.00
Value of Productions,	4,255,820.00	13,863,188.00
Wages Paid,	1,094,796.00	4,636,099.00
Hands Employed,	2,297	9,553

3,841 Patents Granted by the United States.

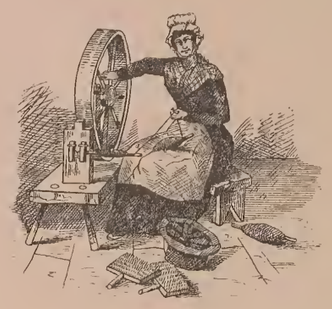
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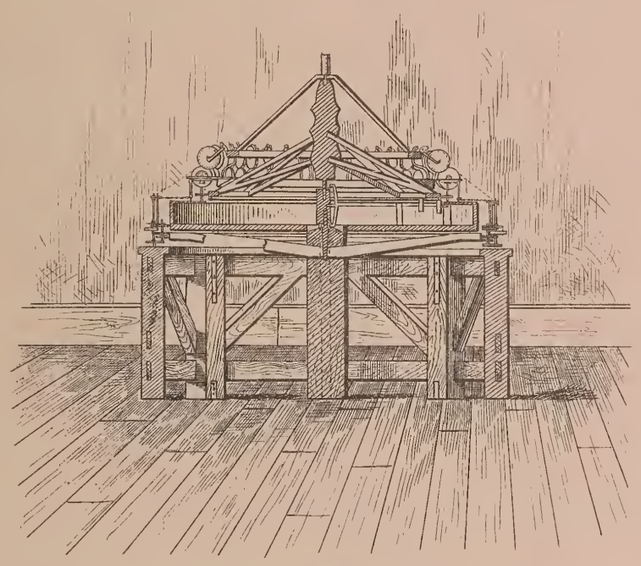
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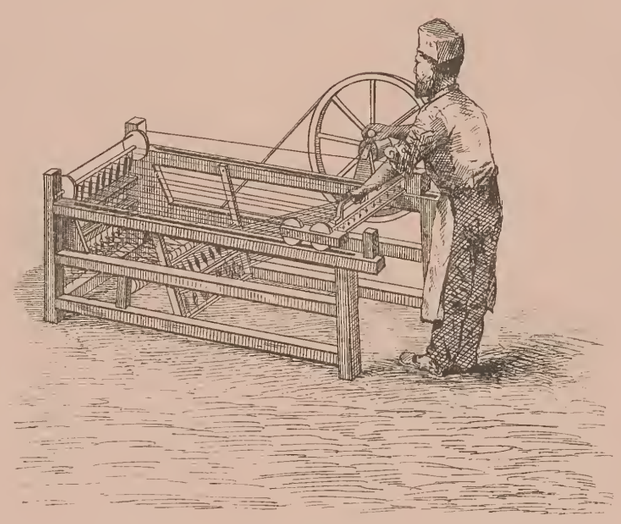
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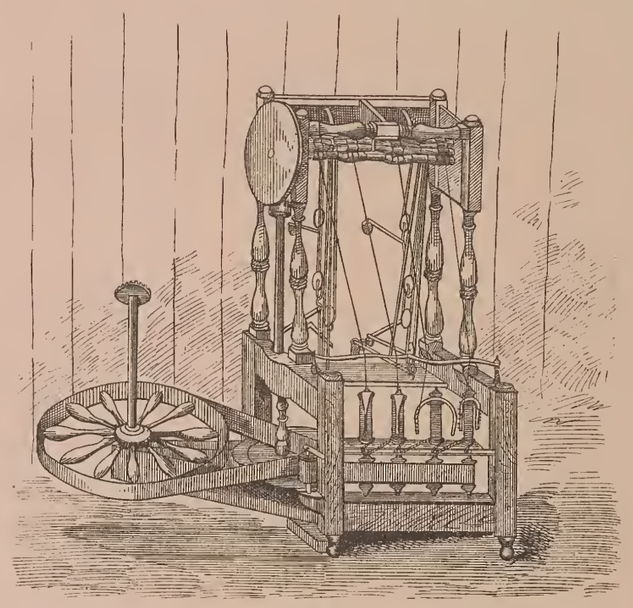
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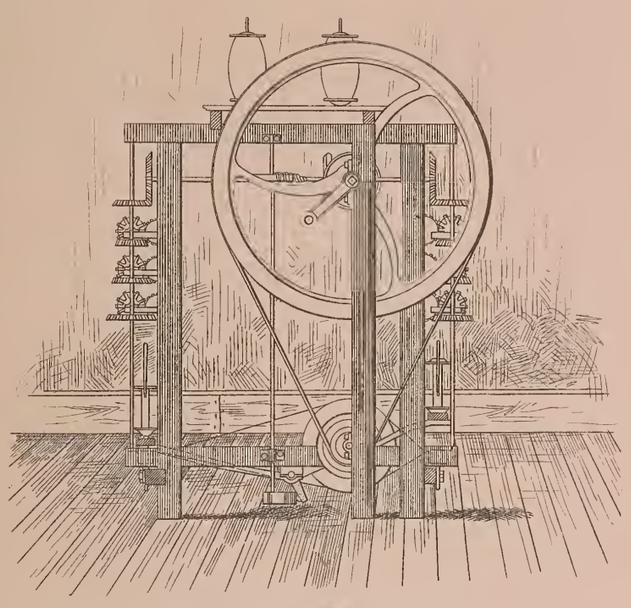
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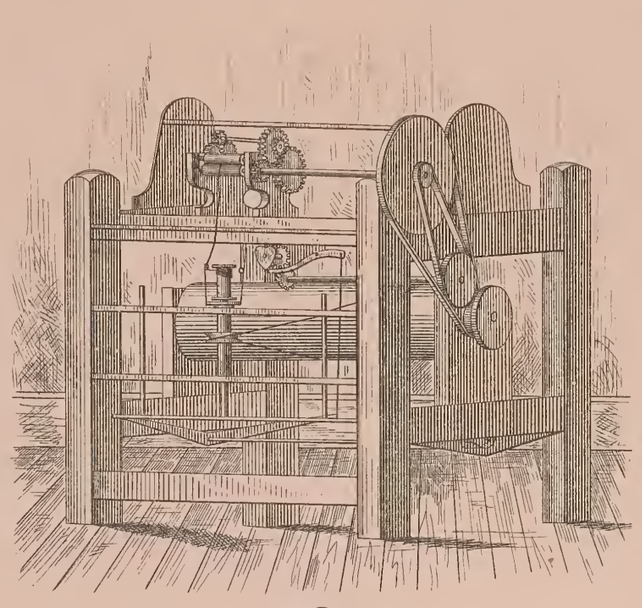
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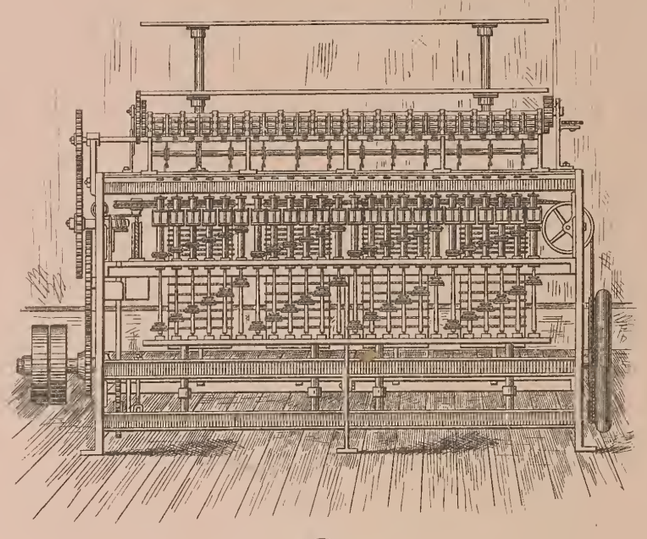
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SPINNING.

SPINNING.

No. 1. Primitive Roman Distaff and Spindle.
2. " Hindoo Wheel.
3. " Britain Wheel.
4. Roller Spinning Machine—A. D. 1758.
5. Spinning Jenny—A. D. 1764.
6. Roller Spinning Machine—A. D. 1769.
7. U. S. Patent, Throstle Frame—A. D. 1816.
8. " " " " —A. D. 1833.
9. " " " " —A. D. 1836.

The art of spinning is, without dispute, of very remote antiquity. When or where thread or yarn was first spun is a question that cannot be answered with any degree of certainty.

Almost all the nations of the world, even those little removed from barbarism, have been found to have early practiced, by some mode, the art of spinning thread and forming it into a web.

The Egyptians say it was Isis who invented and also taught them the art of spinning; the Chinese give the honor of this discovery to the consort of their emperor Yao; the Lydians ascribe it to Arachne; the Greeks to Minerva; the Peruvians to Mamacella, wife to Man-co-copac, their first sovereign. Upon one thing these various claimants agree, and that is that the art was first invented and taught by a *woman*.

The spindle and distaff were the first instruments made use of by the Ancients in spinning. This apparatus was of very simple character. The distaff consisted of a rod of wood or other material, upon which the material to be spun was placed. The spindle for twisting the thread was usually constructed of iron or like heavy material, with a ball of iron or clay at the lower end which acted as a fly-wheel and kept it turning around after it had once got an impulse.

Next after the distaff and spindle, by which some of the finest, most evenly twisted, and most delicate yarns were spun, we have information of a simple form of spinning wheel employed by Hindoo women for spinning the coarser kinds of yarn. The operator of this machine sat upon the ground in front of it and spun the material which she held in her left hand, using her right for turning the wheel.

Long after these means were employed, but how long or when cannot be told, the common spinning wheel, known as the "Jersey" wheel, was introduced, which was a long stride in the improvement of means as regards quantity, but none as to quality of yarn produced. The next step forward was to provide this machine with a treadle.

In 1738 Lewis Paul, (some authorities claim that it was Thomas Highs or Hays,) invented and patented, and in 1758 made entirely practicable, what was known as a "roller" spinning machine, in which the "rolls" or roving "being put between a pair of rollers or cylinders is, by their turning around, delivered to the nose of a spindle in such proportion to the thread made as is proper for the particular occasion. From hence it is delivered to a bobbin spole or quill, which turns upon the spindle, and which gathers up the thread or yarn as it is spun."

As the invention of the needle with the eye through the point made practicable the work of sewing by machinery, so the invention of the "spinning rollers" formed the foundation principle of all the great inventions which can properly be said to belong to machine spinning.

Sir Richard Arkwright, an Englishman, possessed of very high inventive talent as well as unrivalled sagacity, in 1769, improved upon Paul's machine, and brought to a higher state of perfection the "throstle frame," which, though designed only to reduce rovings into yarn, was easily applicable to the manufacture of roving itself.

The next important invention in the art of spinning was made by "a poor man by the name of Hargreaves," who on accidentally overturning a wheel upon the floor when both the wheel and spindle continued to revolve and spin yarn as before, got the idea of placing the spindles in upright instead of horizontal position, and invented the "spinning jenny," which he patented in England in 1777.

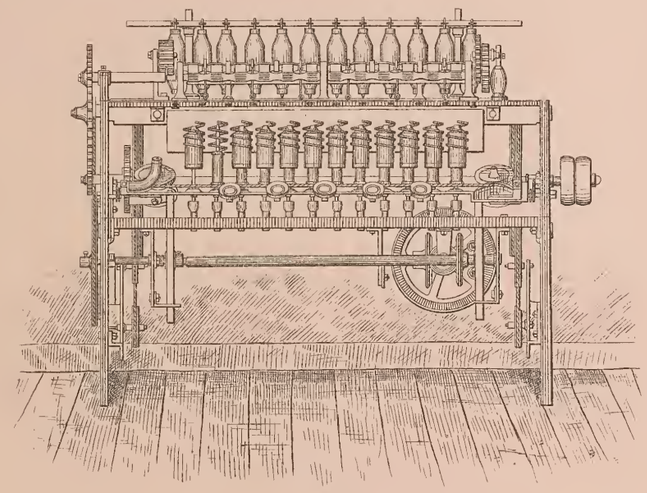
The inventions of Arkwright and Hargreaves "broke down the barrier which had so long obstructed the advance of cotton manufacture," as these machines made it entirely practicable to use cotton in the manufacture of cloth.

Samuel Crompton combined the ideas of Arkwright and Hargreaves in an invention called the spinning "mule," which was greatly improved upon and made self-acting by Richard Roberts, of Manchester, England, in 1825.

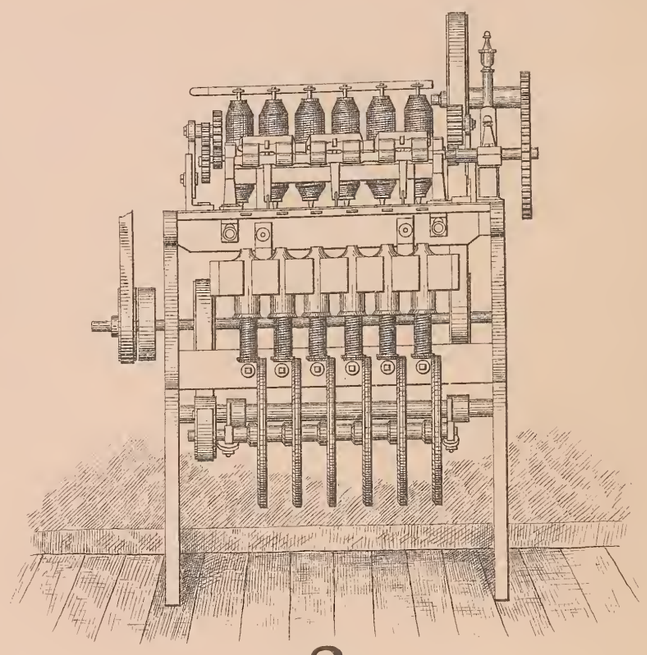
SPINNING.

1,226 Patents Granted by the United States.

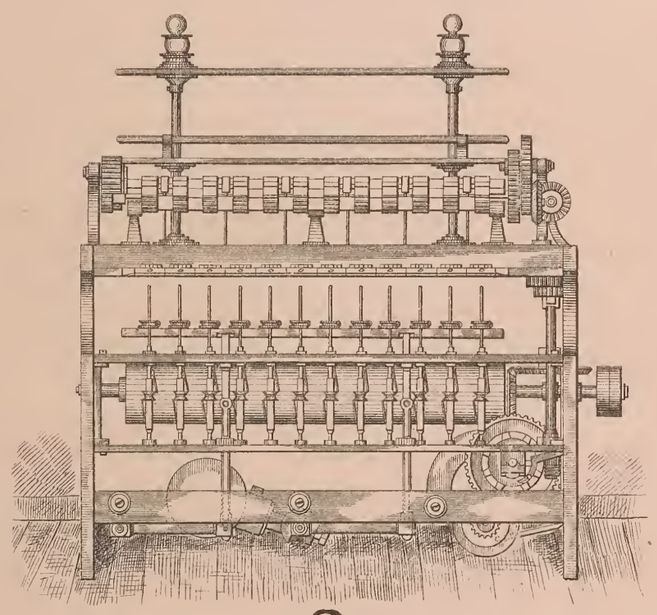
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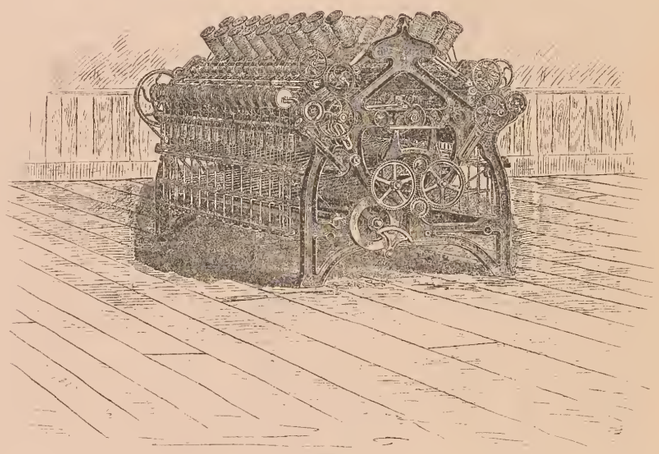
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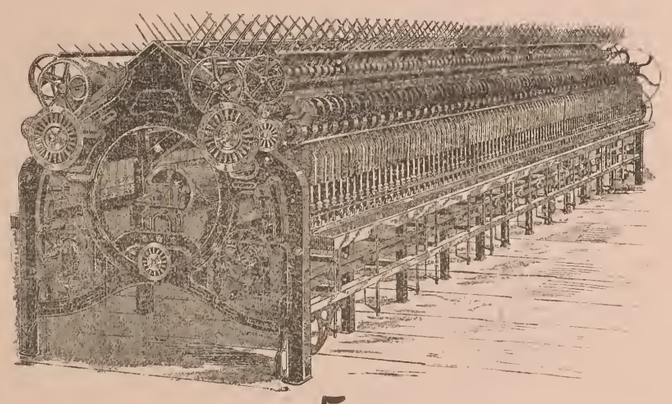
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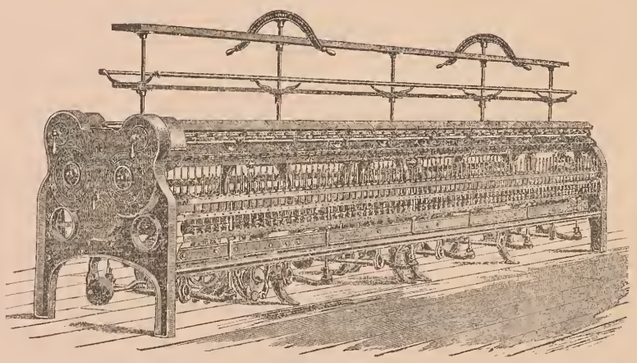
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SPINNING--RING CAP AND FLY FRAME.

SPINNING---RING CAP AND FLY FRAME.

No. 1. U. S. Patent, Cap Frame—A. D. 1841.
2. " " " " —A. D. 1844.
3. " " Ring " —A. D. 1847.
4. " " Fly " —A. D. 1883.
5. " " Cap " —A. D. 1883.
6. " " " " —A. D. 1883.

The "ring frame" is an American invention, having been produced by Mr. Jencks, of Pawtucket, Rhode Island.

This machine has taken the place of substantially all others in the United States for the production of warp, and a good deal of weft, and it is fast supplanting the "mule" for the same purpose in other countries.

In 1807 it is estimated that there were 4,000 spindles in operation in the United States.

In 1883 there were 12,750,000 spindles running on the manufacture of cotton alone, most of these being employed in "ring frames."

It is undoubtedly true that the machinery by which fibers are spun into yarn and the yarn made into cloth is the most wonderful and important that has yet been devised by man.

Spinners have stretched Sea Island Cotton out so fine that one pound of it would reach 1,026 miles.

SPINNING---RING CAP AND FLY FRAME.

588 Patents Granted by the United States.

Seckett & Wilhelms Litho Co New York



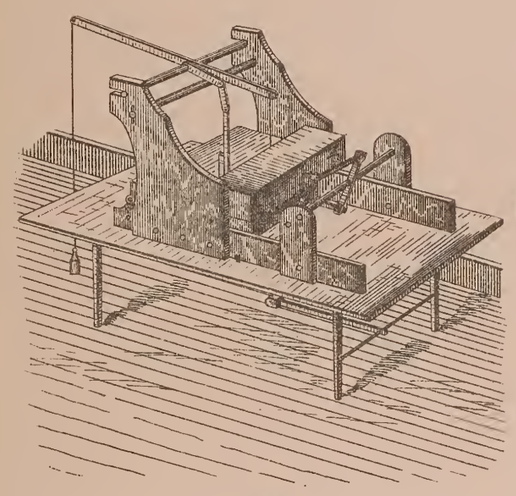
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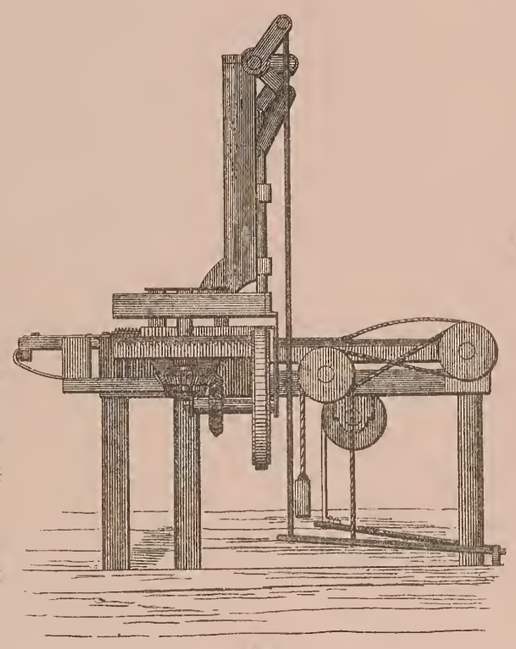
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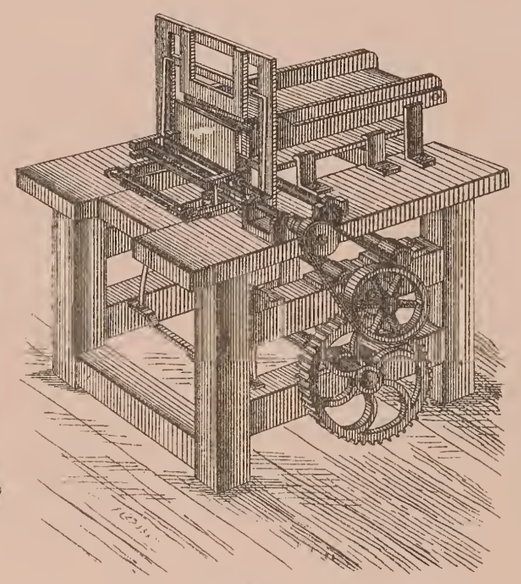
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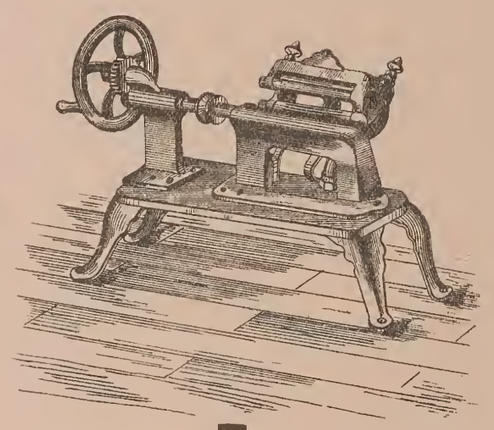
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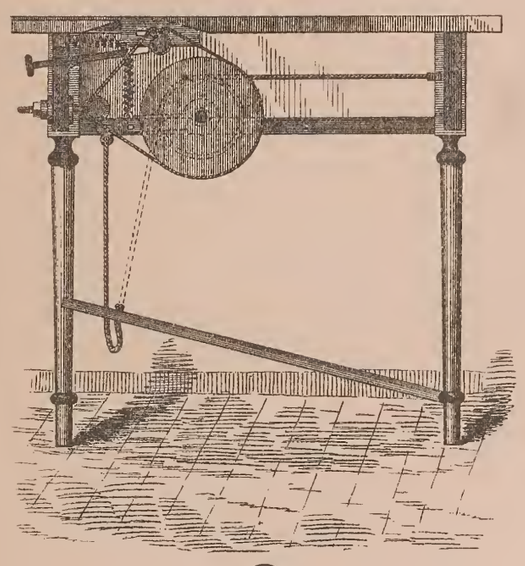
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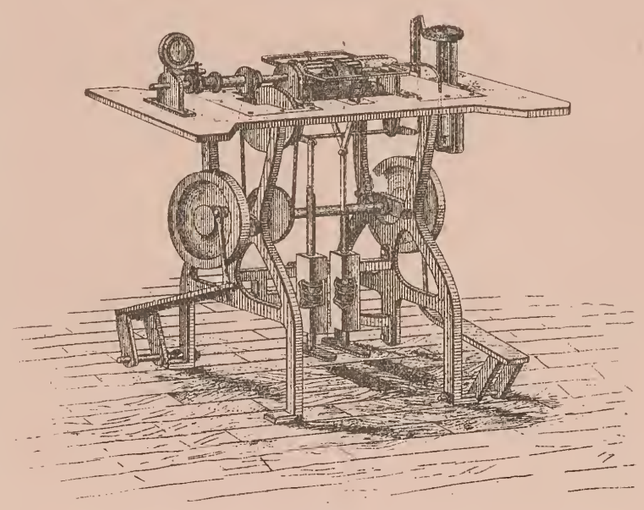
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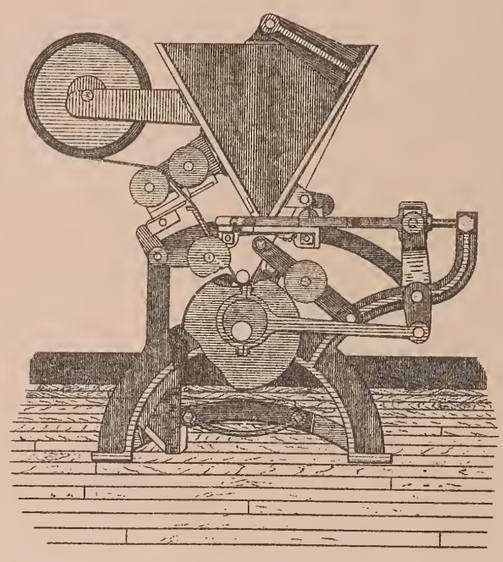
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10

CIGAR MAKING.

CIGAR MAKING.

No. 1. Hand Bunching.
2. " Binding the Bunch.
3. " Wrapping.
4. U. S. Patent, Bunching Machine—A. D. 1847.
5. " " Belt " —A. D. 1847.
6. " " Roller " —A. D. 1852.
7. " " " " —A. D. 1872.
8. " " Belt " —A. D. 1881.
9. " " " " —A. D. 1881.
10. " " " " —A. D. 1884.

The name "cigar" is derived from the Spanish cigarro, a kind of tobacco grown in Cuba.

The Aztecs, of Mexico, are spoken of by Sahagun in his history of New Spain as "using leaves of tobacco rolled into cigars."

The cheroot is the cigar of the Manillas, and has a regular taper, but both ends are cut squarely off and one end is smaller than the other.

Although cigars are of ancient origin in the West Indies, they were not generally known in Europe until the beginning of the 19th century.

Previous to 1820 the manufacture of cigars in Cuba was a government monopoly.

In Mexico a cigar is called a "puro;" in Peru it is called a "cigarro puro."

The process of the manufacture of Havana cigars is as follows: Arrived at the factory, the tobacco bales, carefully packed and wrapped in palm leaves, are kept in a cool, dark place, being divided off into classes according to quality and value. When the cigar bales are opened the Manojas and Zatellor are separated, and the latter carried in their dry state to the moistening room; here the leaves are placed in a large barrel, in which is a solution of saltpetre in water. Then the water is poured off and the leaves spread upon the edge of the barrels, thus ridding them of any surplus of water; the stem is then taken out; the maker then supplies himself with a handful of leaf (copa) for wrappers, and a lot of the filler (tupa), carries them to a table, and spreading a wrapper upon the table cuts with a short knife the different portions of the leaf. He then lays the wrapper on the table and takes a few fragments of tobacco or a leaf strip in the center and rolls the whole into the shape of a cigar, and then taking the wrapper rolls it spirally around the cigar.

It is stated that, as the best tobacco grows in Cuba, so, also, the best cigars are made there.

The best cigars are made of tobacco which is grown on soil peculiarly adapted to produce the delicate flavor. A portion of the northwest of the Island of Cuba is said to be the best soil. Connecticut Valley, some parts of Virginia, a few counties of Ohio and Kentucky, respectively, are noted regions.

The process of making cigars by hand is simple and easy. A round piece of leaf shaped like one of the gores of a globe is placed on the work bench, a bundle of fragments of leaves is placed across the center of the gore, and rolled up in it by passing the hand flat over it.

Cigar machines are of modern invention.

The tobacco leaf selected for cigars is first steamed, stemmed, flavored and dried, after which it is rolled on the rolling machine into proper form for fillers; one machine cuts them and rolls into proper length as they are fed to it; another takes this "wad," moulds it into the cigar shape and it is then ready for the wrapper. The wrapper is placed in another machine and the perfected filler laid bias on the leaf, which is rolled by a pad that simulates the action of the human hand. The cigars are then usually placed in a press, bundler or mold, after which they are ready for boxing.

CIGAR MAKING.

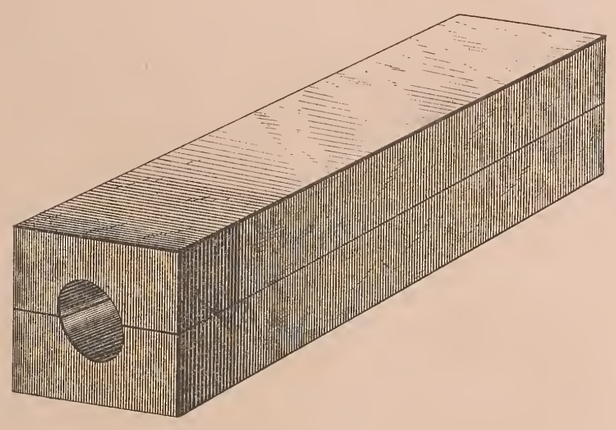
7,145 Manufactories of Cigars and Cigarettes in the United States.

	1860	1886
Capital Invested,	$3,035,555.00	$21,698,549.00
Value of Productions,	9,068,778.00	63,979,575.00
Wages Paid,	2,531,354.00	18,464,562.00
Hands Employed,	7,997	53,297

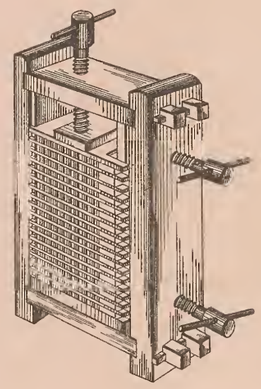
Capacity—	Primitive Mode.	Present Machine.
Number per day,	500	7,500
Hands Employed per day,	2	2

199 Patents Granted by the United States.

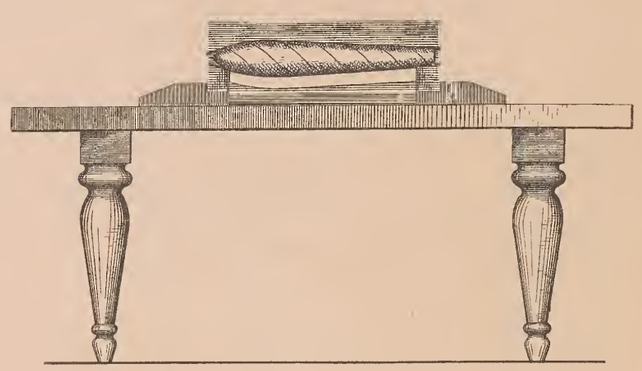
Sackett & Wilhelms Litho Co New York



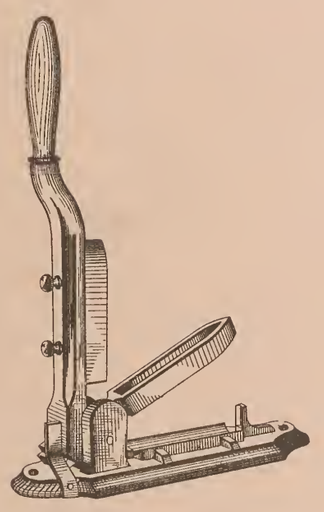
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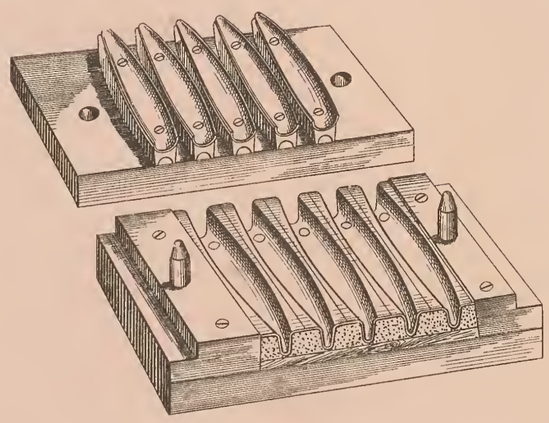
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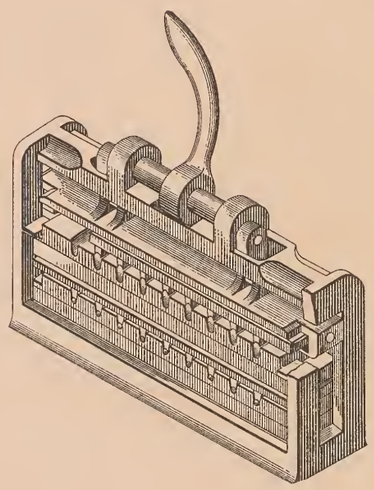
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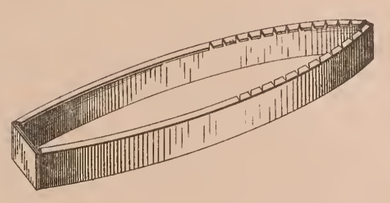
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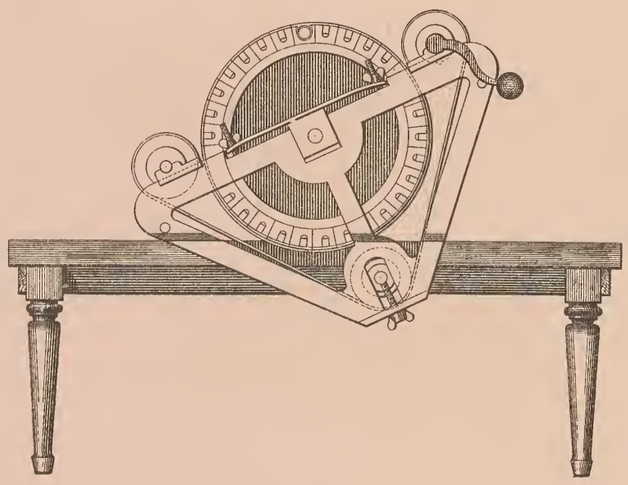
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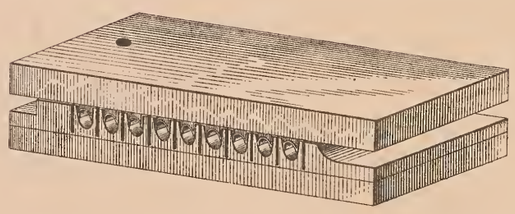
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9

CIGAR MOLDS.

CIGAR MOLDS.

No. 1. Common Cigar Mold.
2. U. S. Patent, Gang Mold and Press—A. D. 1866.
3. " " Plunger Mold—A. D. 1871.
4. " " Lever Mold—A. D. 1875.
5. " " Motal Lined Mold—A. D. 1876.
6. " " Gang Mold—A. D. 1879.
7. " " Combined Wood and Metal Mold—A. D. 1880.
8. " " Roller Mold—A. D. 1882.
9. " " Sheet Metal Plunger Mold—A. D. 1884.

Great skill has been attained in American factories in making cigars, so much so that it is difficult to discriminate between the genuine and spurious article excepting by trial, and even then in some cases it requires the nicest taste to detect the difference.

Many persons engaged in the business import tobacco from Cuba, use the Connecticut leaf for wrappers, and produce an article equal to the best made in Havanna.

The consumption of cigars extends all over the globe, and increases yearly in a wonderful ratio.

In making cigars by hand it is usual for the operator to grasp the leaves and pieces of tobacco in the hand, and give to the same a shape corresponding generally to the cigar when made. The largest quantity of material is to be in the central portion and less towards the ends of the cigar.

In the manufacture of cigars it is usual to employ wooden molds, into which are placed the bunches or bodies of the cigars. These molds are each of the proper shape for the exterior of the bunch, and when the molds have been filled they are subjected to powerful pressure to shape the bunches. The bunches are in a more or less moist condition, and in consequence of being firmly held the tobacco cannot expand; besides this the cigar body is difficult to remove from the mold after being pressed. To facilitate this removal it is usual to allow the tobacco to project beyond the mold at the tuck or larger end of the cigars, so that such tobacco may be grasped in the fingers to lift the bunch from the mold.

Many improvements have been made for overcoming the difficulties in molds, such as two-part cigar molds, divided into sections with guide bars, &c.

CIGAR MOLDS.

3 Manufactories of Cigar Molds in the United States.

	1880
Capital Invested,	$69,800.00
Value of Productions,	111,820.00
Wages Paid,	32,020.00
Hands Employed,	76

107 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



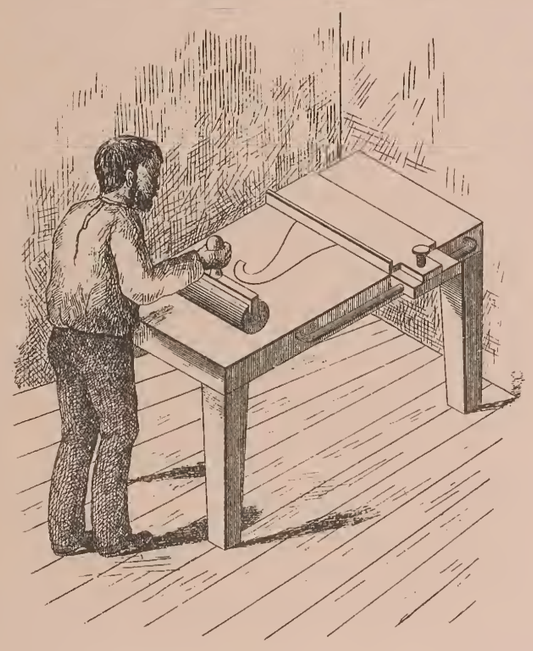
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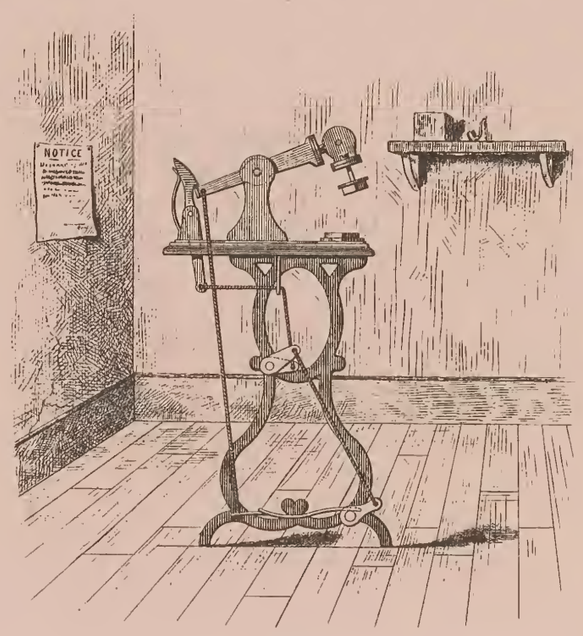
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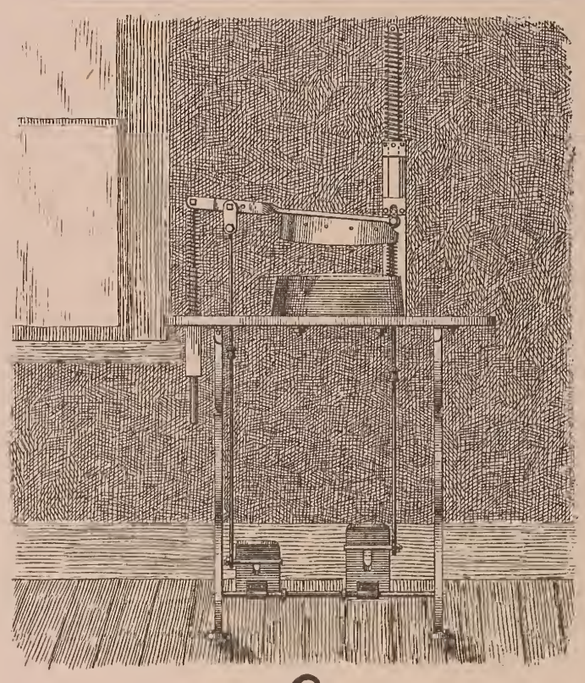
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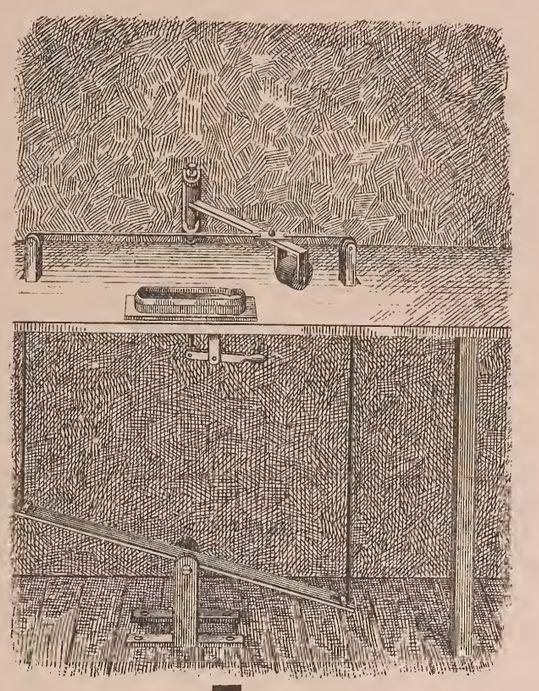
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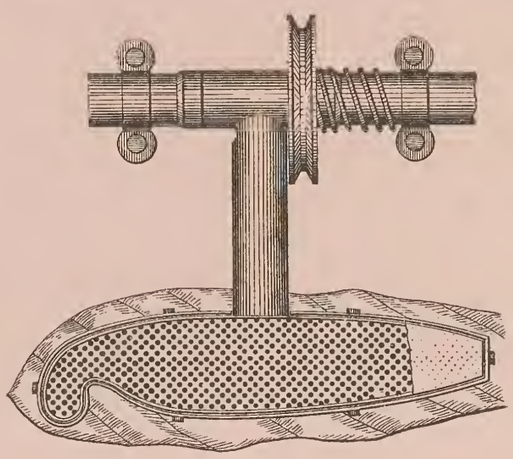
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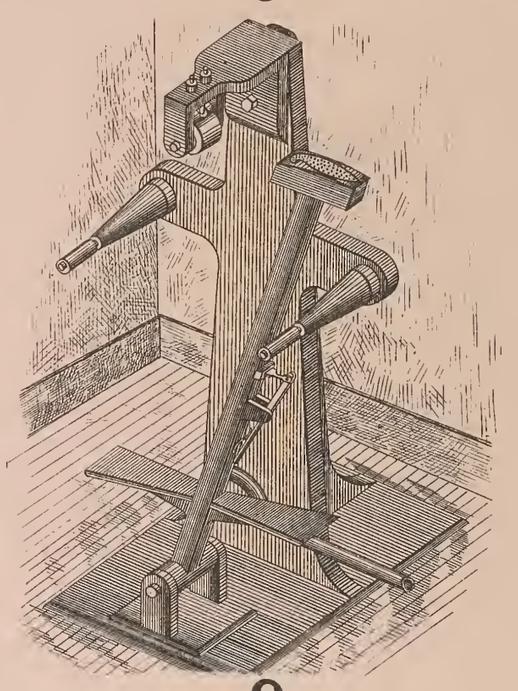
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CIGAR WRAPPER CUTTERS.

CIGAR WRAPPER CUTTERS.

No. 1. Hand Cutting.
2. U. S. Patent, Cutting Die—A. D. 1866.
3. " " Roller Cutting Dies—A. D. 1869.
4. " " Hand Roller and Die Cutter—A. D. 1873.
5. " " Lever Cutter—A. D. 1877.
6. " " Rocking Lever Cutter—A. D. 1881.
7. " " Reciprocating Roller and Cutter—A. D. 1883.
8. " " Suction Wrapper, Holder & Cutter—A. D. 1884.
9. " " Suction Wrapper Cutter—A. D. 1884.

Cigars constitute the most important form in which tobacco is consumed for smoking, and in fact the largest aggregate in general consumption in any form, and their greater value induces every effort to produce leaves suited for the covering of cigars.

The cigar is of Spanish, or Spanish colonial, origin, and it was long in use in Spain before it was introduced elsewhere.

The finest cigars are manufactured at Havana, Cuba. Uniformity in size, length, weight and color, is essential. The Havana cigars are tied in bundles of from twenty-five to fifty each, and are packed in boxes of Spanish cedar.

A very superior article of tobacco for the exterior wrappers of cigars is grown in Connecticut.

Many persons engaged in the manufacture of cigars import tobacco from Cuba and use the Connecticut leaf for wrappers, and produce an article equal in appearance to the very best Havana cigar.

The operation of making cigars by machinery is conducted in a series of machines: one cuts wads of cigar length and quantity from a stream of cigar leaves packed and traversing a chute whose width is equal to the length of the cigar; the wad thus cut off is driven into a mold which gives it the cigar shape. In this it is left to dry, so that when removed it only requires the wrapper to complete it. These molds are made of wood or metal, principally the latter, and, since a great increase in the demand for cigars, a large number of molds are inserted into one beam or bar of metal; a sharp knife is fixed to this beam or bar, so that it descends close to the edge of the mold, thus leaving the cigars smooth at the larger end and of equal length.

The finest cigars are hand-made.

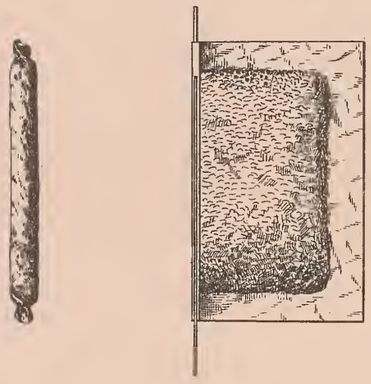
CIGAR WRAPPER CUTTERS.

74 Patents Granted by the United States.

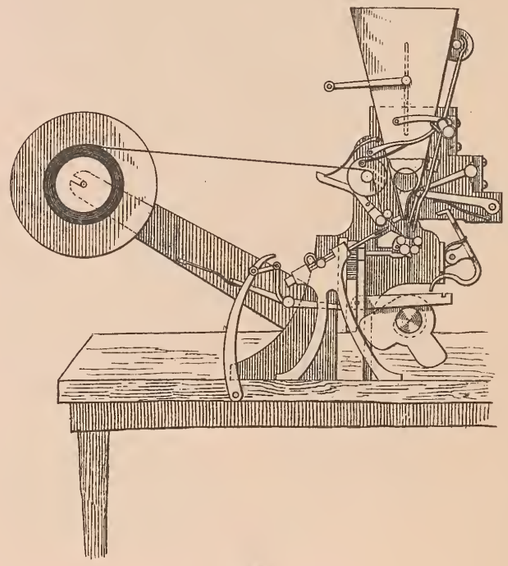
Seckett & Wilhelms Litho Co New York



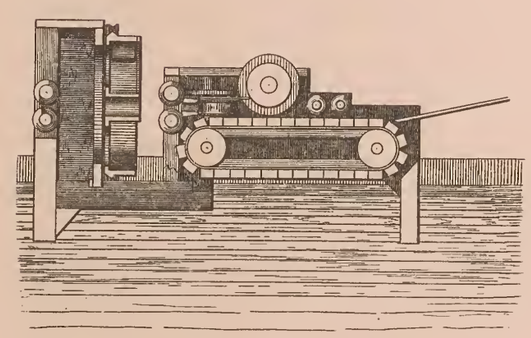
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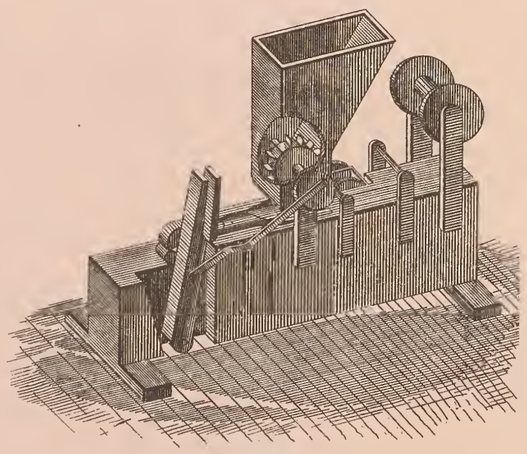
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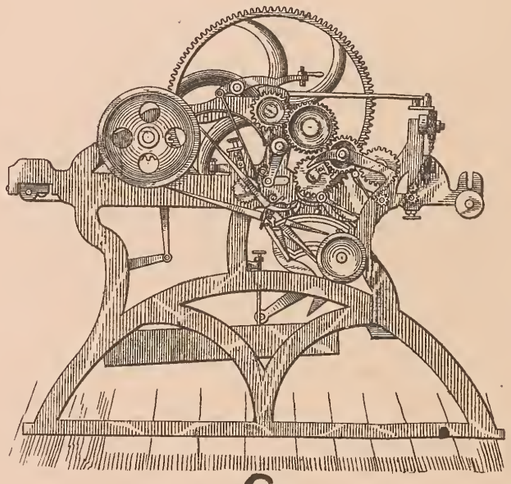
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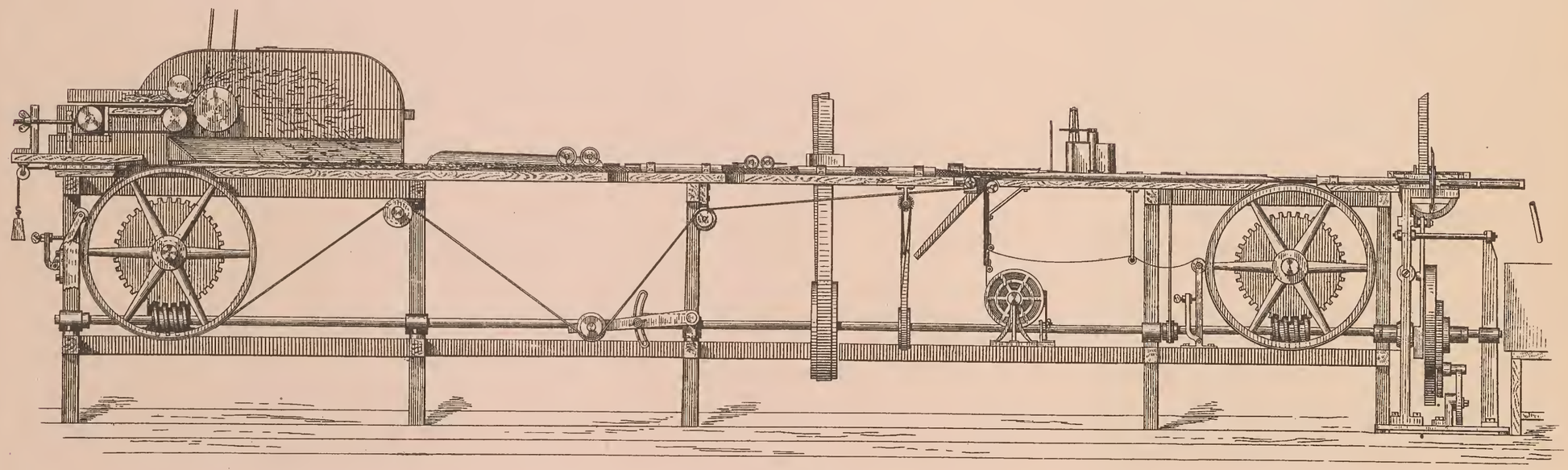
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CIGARETTE MAKING.

CIGARETTE MAKING.

No. 1. Hand Rolling.
2. U. S. Patent, Hand Rolling Device—A. D. 1858.
3. " " Roller Machine—A. D. 1865.
4. " " Continuous Filler Machine—A. D. 1872.
5. " " " " " —A. D. 1876.
6. " " Cigarette Machine—A. D. 1882.
7. " " " " —A. D. 1884.

Tobacco in the form of cigarettes is extensively used by the inhabitants of Nicaragua, Guiana and the dwellers on the banks of the Orinoco, and the use of the weed is not confined to the male sex, but is freely used both by women and the juvenile portions of the community.

In Russia cigarettes are called parporos, and consist of Turkish tobacco rolled in silk paper. The ladies almost all smoke the small, delicate size of parporos, while the gentlemen smoke the larger ones. On the cars are fixed little cups for cigar ashes in every seat. Instead of having smoking cars, as in the United States, the Russians have cars for those who are so "pokey" as not to smoke.

The favorite mode of smoking in Austria is the cigarette, almost every gentleman having a silver box in which he has tobacco and small slips of paper with mucilage on them ready for rolling.

In Turkey the girl of twelve years smokes a cigarette of the thickness of pack thread; after fourteen years of age the diameter of the cigarette increases year by year.

The cigarette is chiefly smoked in Peru.

In Cuba cigarettes are called cigarros.

Cigarettes were first made in the French government manufactory in 1843. The tobacco granulating machine is used for grinding tobacco ready to fit it for making into cigarettes.

The most improved cigarette machine uses an endless roll of paper. It cuts, wraps and folds the paper around a regulated quantity of tobacco, which is supplied at one end of the machine, while the finished cigarettes emerge at the other.

CIGARETTE MAKING.

7,145 Manufactories of Cigarettes and Cigars in the United States.

	1860	1880
Capital Invested, -	$3,035,555.00	$21,698,549.00
Value of Productions, -	9,068,778.00	63,979,575.00
Wages Paid, - -	2,531,354.00	18,464,562.00
Hands Employed, - -	7,997	53,297

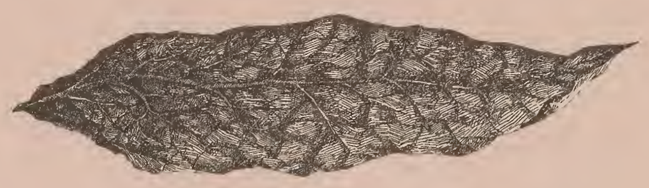
Capacity—	Primitive Made	Present Machine
Number per day, . . .	2,000	50,000
Hands Employed per day, . .	1	1

51 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



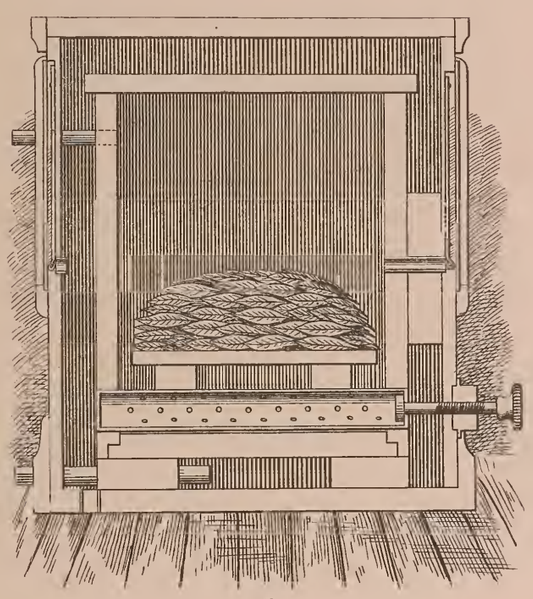
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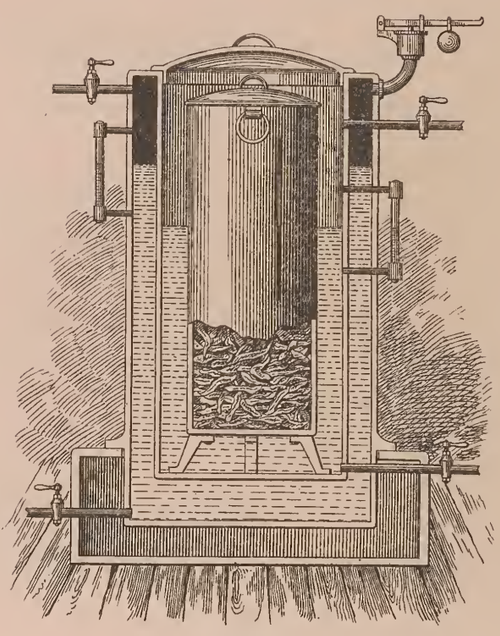
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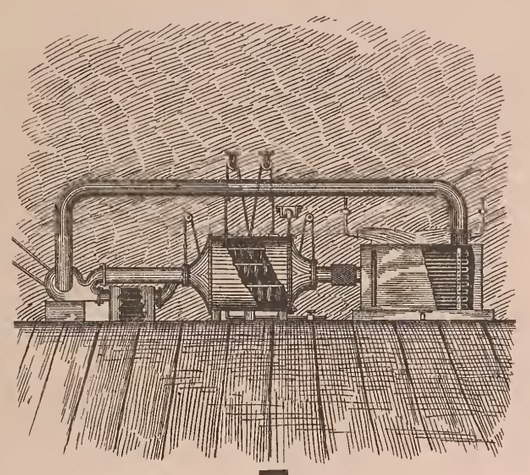
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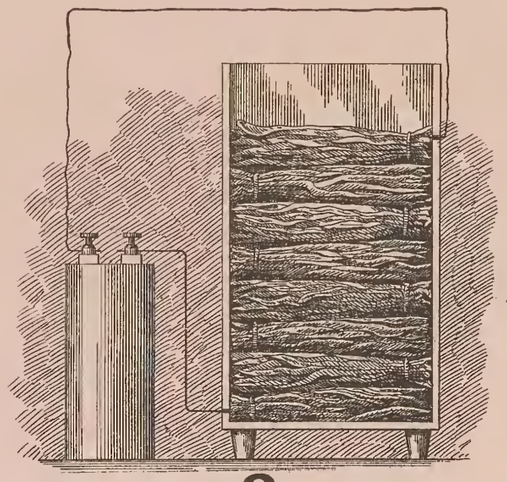
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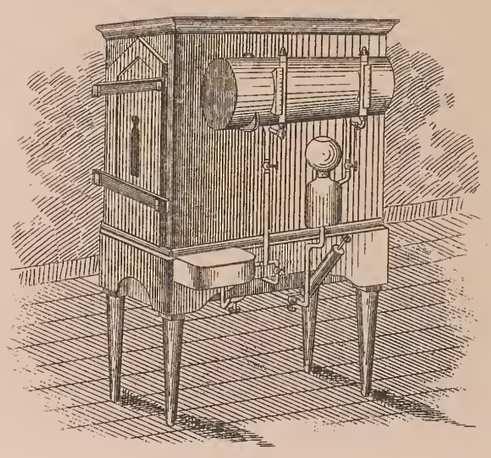
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TOBACCO CURING.

TOBACCO CURING.

No. 1. Plant.
2. Leaf.
3. Primitive Curing.
4. U. S. Patent, Sweating—A. D. 1869.
5. " " " —A. D. 1876.
6. " " Curing—A. D. 1880.
7. " " Treating—A. D. 1880.
8. " " Electric Curing—A. D. 1882.
9. " " Resweater—A. D. 1884.

The house or barn in which tobacco is to be cured is opened in a damp time, the tobacco is taken from the poles and put in piles; after remaining in piles for one week it is stripped, that is, the leaves are taken from the stalk, assorted, and put into hands weighing about four ounces.

The next process is bulking. The hands are stacked in a compact heap, the butts together and the leaves smoothed down. When the pile is four feet high planks and weights are put on, and sometimes it is covered with blankets. In this state it remains from four to six weeks, until the color, flavor and other qualities are properly developed, when it is packed for market.

It is the fermentation in the process of curing which evolves the peculiar aroma of tobacco.

Various "liquors," or fluid mixtures, are used to promote this fermentation, and, at the same time, to give the tobacco that peculiar flavor which constitutes the difference of samples.

With some of their choicest "Cavendish" the Americans use cider, and the tobacco growers of Havana apply a fluid mixture of various aromatic gums, the composition of which they have managed to keep secret. The Germans and the Dutch use a compound of sal ammoniac, nitre, and, it is said, the fluid secreted by the kidneys.

The speed of the fermentation will depend upon the surrounding temperature. Thirty-six hours will sometimes suffice. When to stop this fermentation is the important point of the process. It must be stopped at attaining a precise degree of heat, which is not scientifically determined, as in brewing, the practised hand being the only means of testing the temperature of the heated mass, which is ascertained by shoving in the hand.

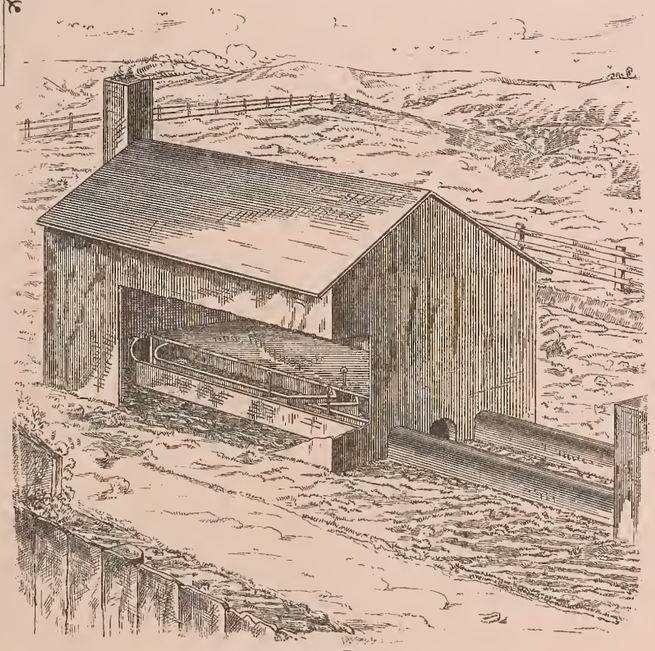
Heated above or below that point, which practice makes easy of detection, the tobacco would be "foxy" or musty, and become deteriorated in the market. The fermentation is stopped in its intensity by simply uncovering the mass and spreading out and turning over the leaves, more or less saturated with moisture.

It is certain, however, that a mild and slow fermentation constantly exists in all tobacco, varying with the degree of moisture in the air, thus still further tending to improve its good qualities, as in the best American and Havana, and to intensify its bad qualities, as in inferior productions. This explains the necessity for "keeping" the prime Havanas, which decidedly "improve by age," reversing the lot of all other things in this best of possible worlds.

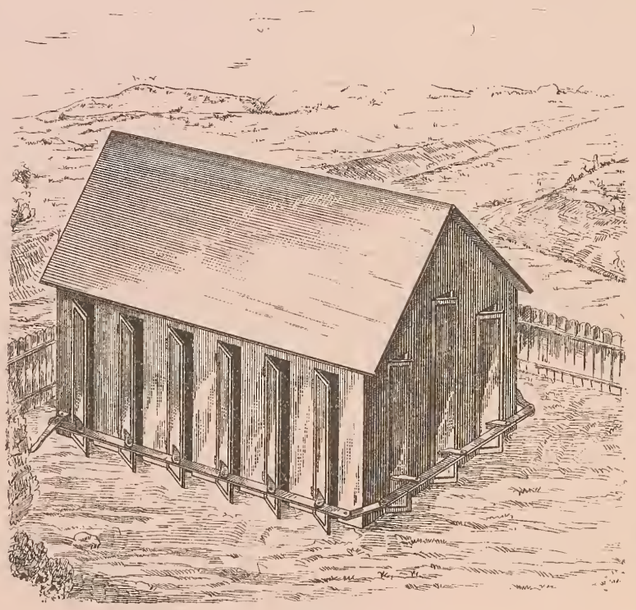
TOBACCO CURING.

80 Patents Granted by the United States.

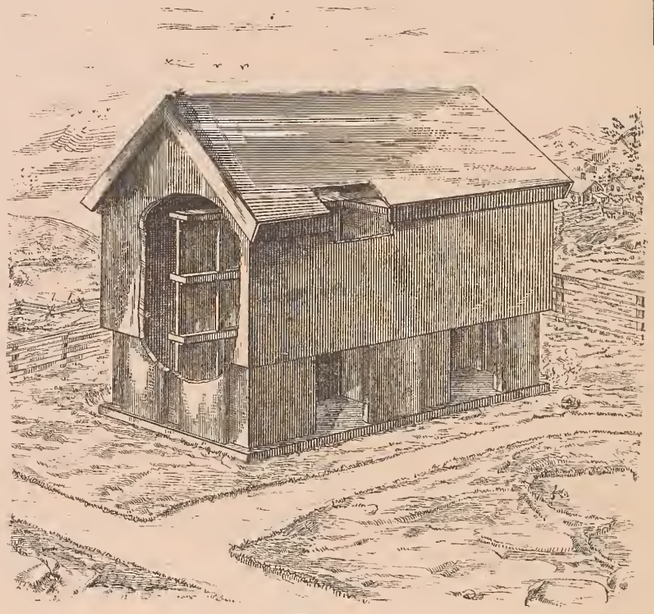
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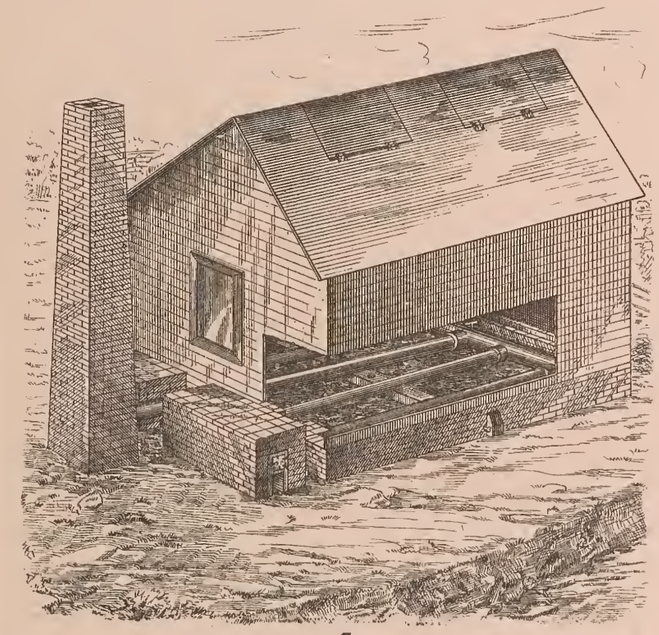
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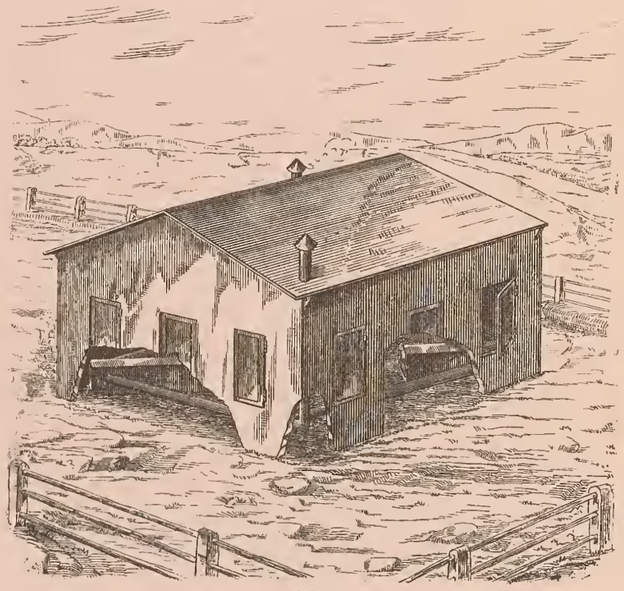
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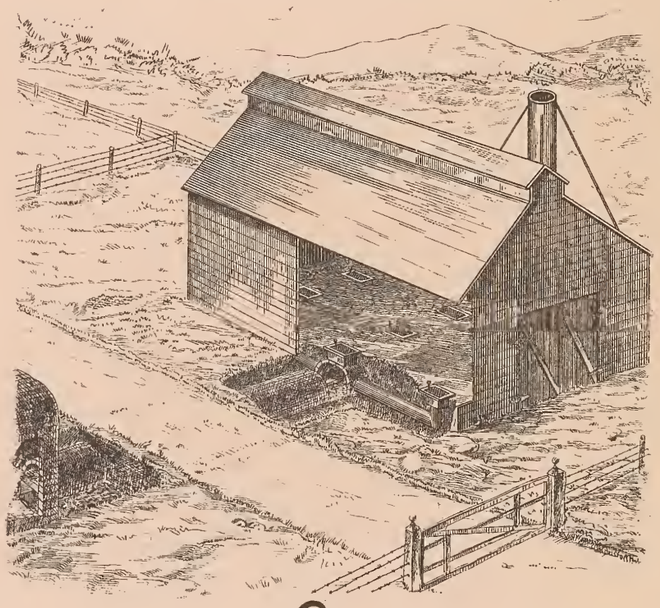
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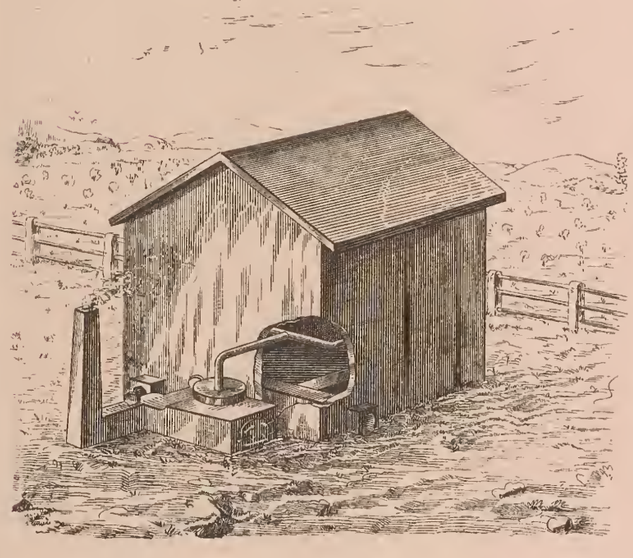
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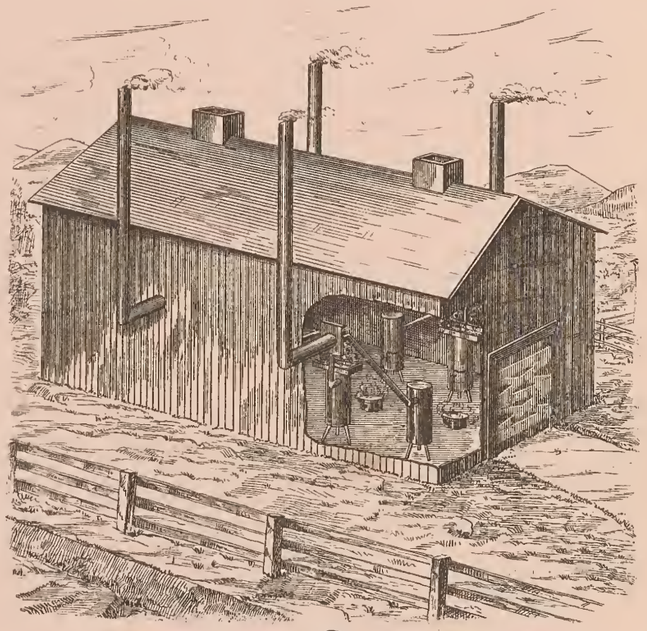
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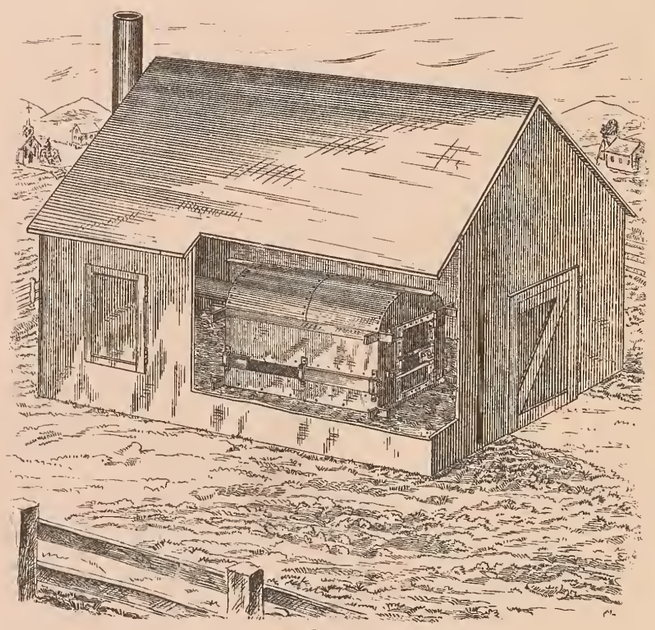
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TOBACCO DRIERS.

TOBACCO DRIERS.

No. 1. U. S. Patent, Drying Furnace—A. D. 1861.
2. " " Drying House—A. D. 1872.
3. " " Drying House—A. D. 1873.
4. " " Drying Furnace—A. D. 1876.
5. " " Drying Room and Furnace—A. D. 1878.
6. " " Drying and Curing—A. D. 1878.
7. " " Drying House—A. D. 1880.
8. " " Drying Barn—A. D. 1882.
9. " " Curing Furnace—A. D. 1884.

Tobacco is usually cured in large barns upon the farm where it is raised, and the value of the crops depends upon the success of this process.

These houses, or barns, are arranged so that the ventilation is under perfect control.

The tobacco in "hands" is hung upon poles with the tops hanging downwards, the distance being regulated so that the leaf will not "pole burn."

The latest improvement in curing is the introduction of heat and air by means of flues.

Until a recent period the barns for curing the crop of tobacco were very inferior, rude structures, made of rails covered with straw.

TOBACCO DRIERS.

43 Patents Granted by the United States.

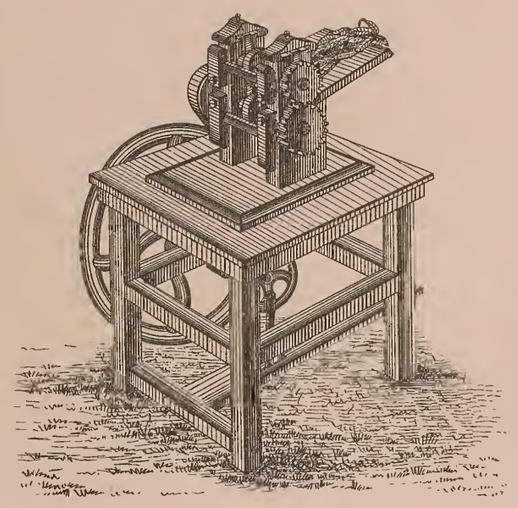
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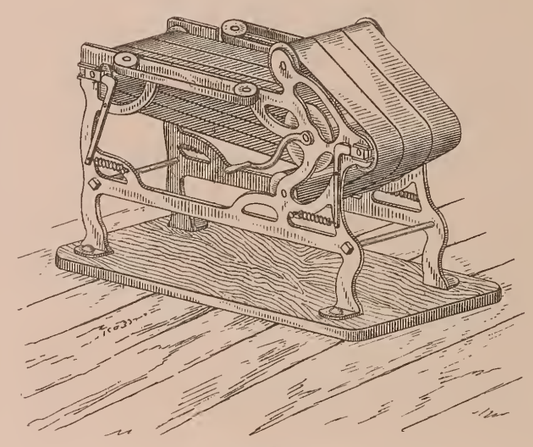
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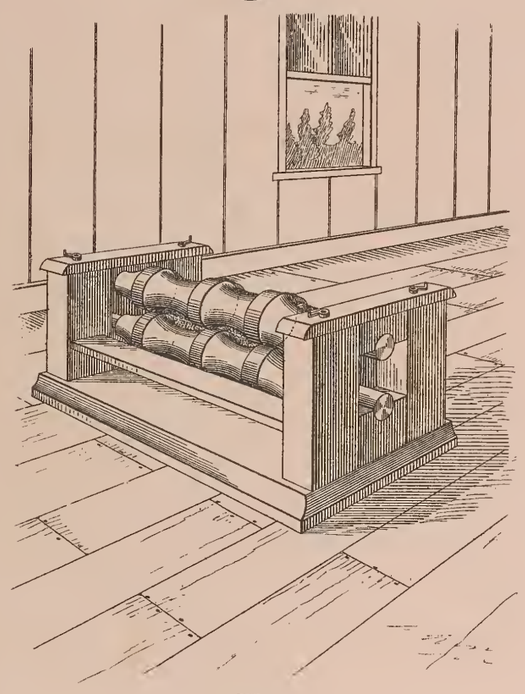
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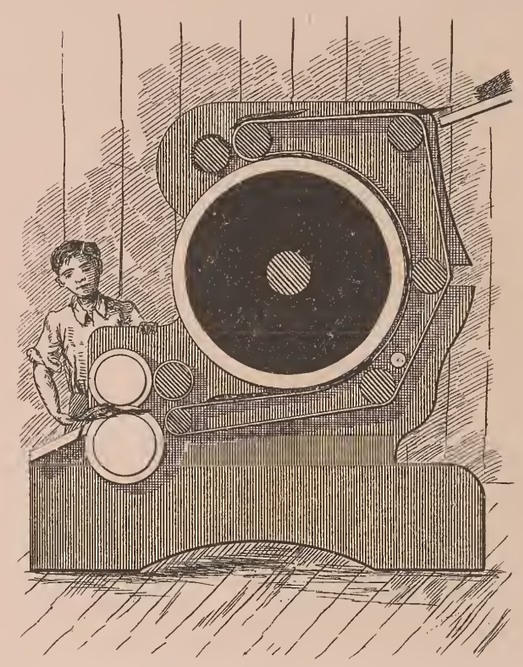
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TOBACCO LEAF TREATING.

TOBACCO LEAF TREATING.

No. 1. Hand Mid Rib Crushing.
2. " Booking.
3. U. S. Patent, Crushing—A. D. 1862.
4. " " Stripping—A. D. 1868.
5. " " Stripping and Brushing—A. D. 1873.
6. " " " Drying—A. D. 1878.

The tobacco plant is found principally in America. The cultivation of it had extended, before the discovery of Columbus, far to the north of the regions in which it appears to be indigenous.

It is doubtful whether the use of tobacco as a narcotic was known in the East before the discovery of America, though Meyen in his *Geography of Plants* expresses the opinion that the smoking of tobacco is of great antiquity among the Chinese. He bases this opinion on the fact that he found on some very old Chinese sculptures the very same tobacco pipes which are now in use.

Meyen's authority is, however, greater as a botanist than as an archæologist, and as the habit never seems to have been introduced by the Chinese to other oriental nations, it is probable America can claim to have taken the initiative in teaching the world to smoke.

The tobacco plant which ripens in the sun produces the yellowest and sweetest leaf. These leaves must be gathered, however, before the frost bites them, otherwise they will turn very dark and lose the desired flavor. After the tobacco is cut the leaves should be taken one by one from the stalk, strung on a wire rod and suspended in rows in the flue-curing barns, built expressly for the drying of tobacco. After the leaf is properly dried, it becomes a bright yellow. It is now ready for market, if it is to be sold in the raw state.

Before placing the leaf tobacco on the market it is customary to bind a number of leaves together, thus making a sheaf of leaves, the effect of which is quite pretty. The manufacturer first strips the leaf of its hard central stem; then the leaf is crushed to make smoking tobacco, or pressed into compact and highly perfumed "plugs" and packages for chewing, powdered into snuff or rolled into cigars.

A more primitive way of drying the leaves was to suspend them while on the stalk on a square stick, which was hung across the beams of the tobacco barn.

Sheeting tobacco consists in laying the leaves out smoothly in sheets. This is done by passing the leaves between rollers, which flatten them, devices acting in concert with the rollers to draw out the w rkl s.

Sometimes revolving brushes are used, acting obliquely to the direction of motion of the leaf.

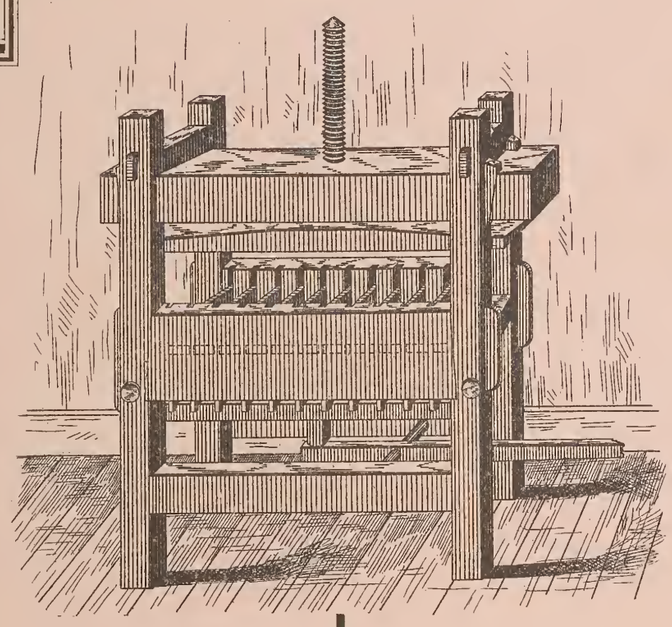
In sheeting tobacco it is sometimes laid in symmetrical piles known as books.

Tobacco is also sheeted and stripped by the operation of laying the broad portions of the leaf flat, and separating them from, or flattening, the stem, as the case may be.

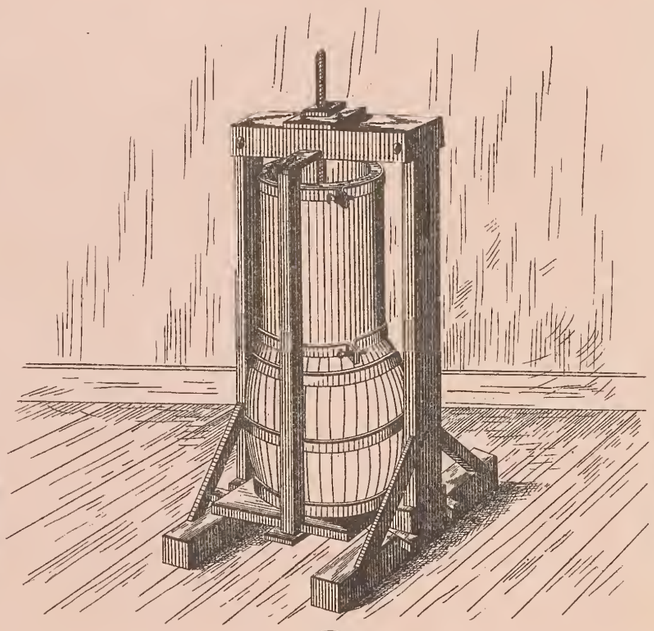
TOBACCO LEAF TREATING.

38 Patents Granted by the United States.

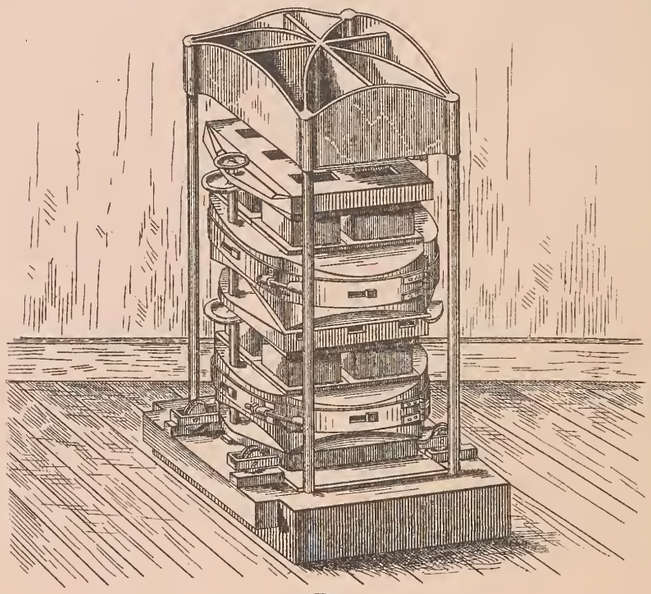
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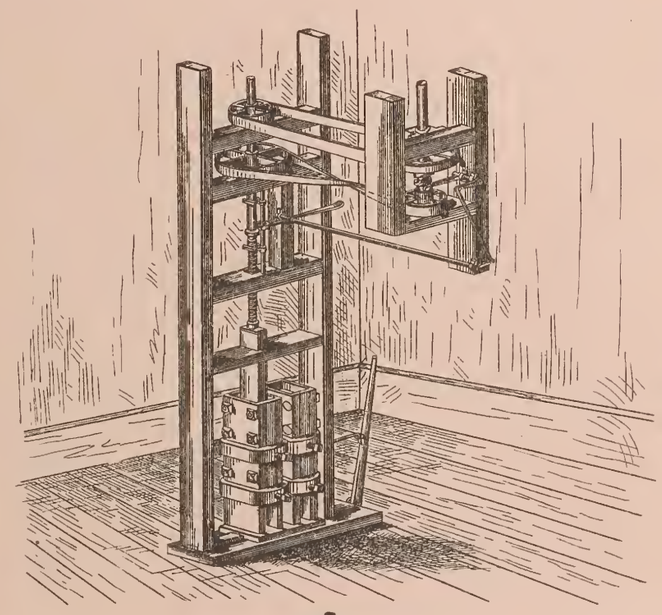
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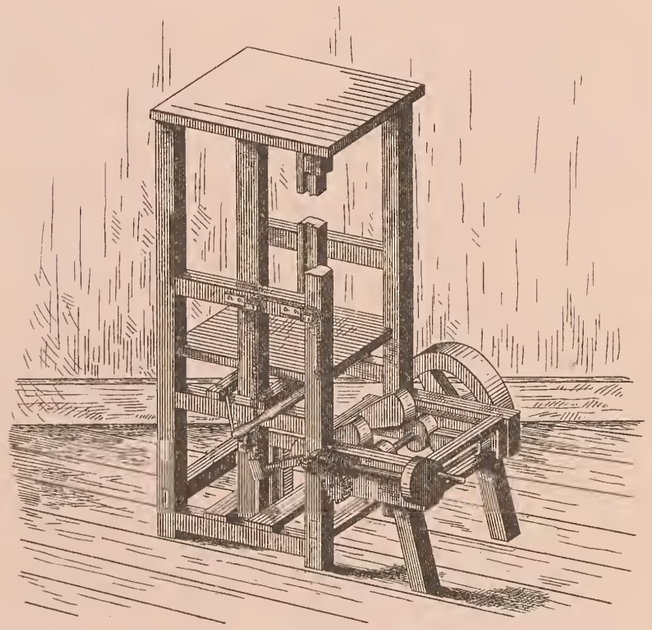
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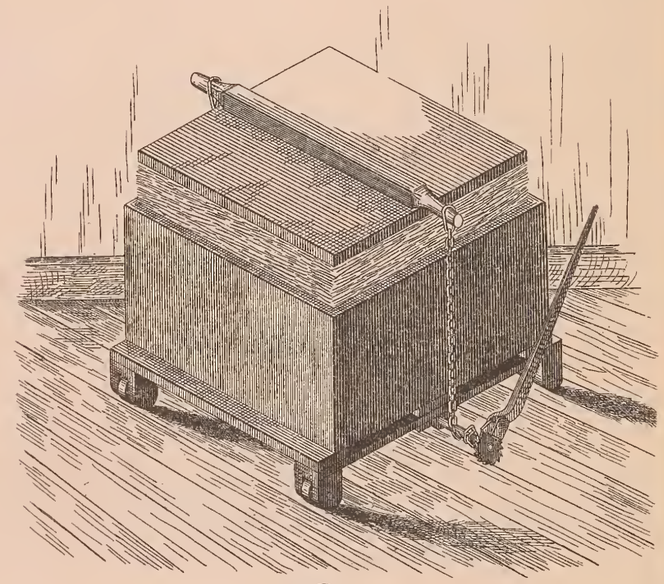
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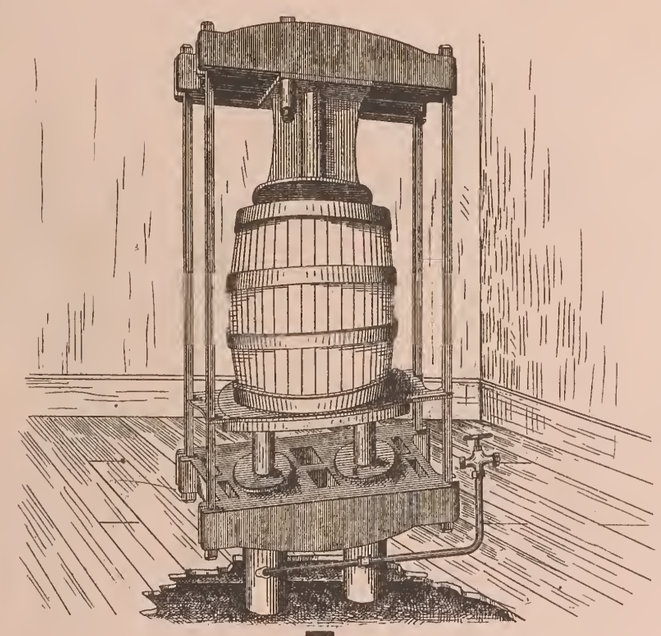
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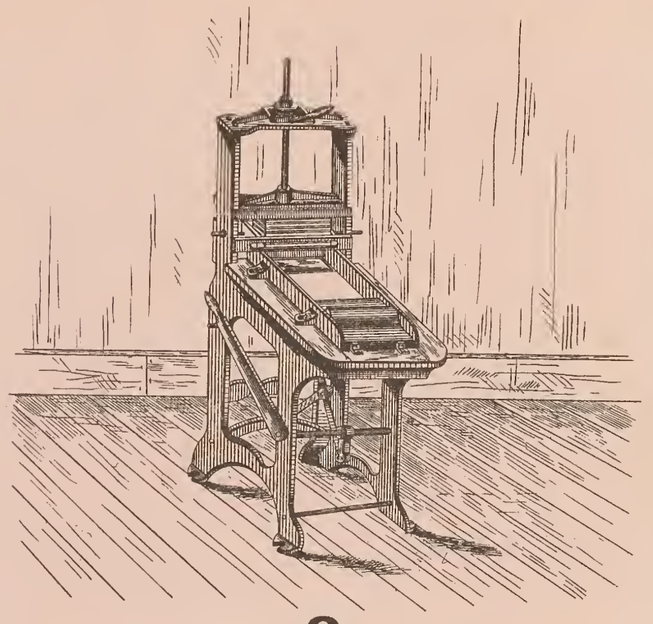
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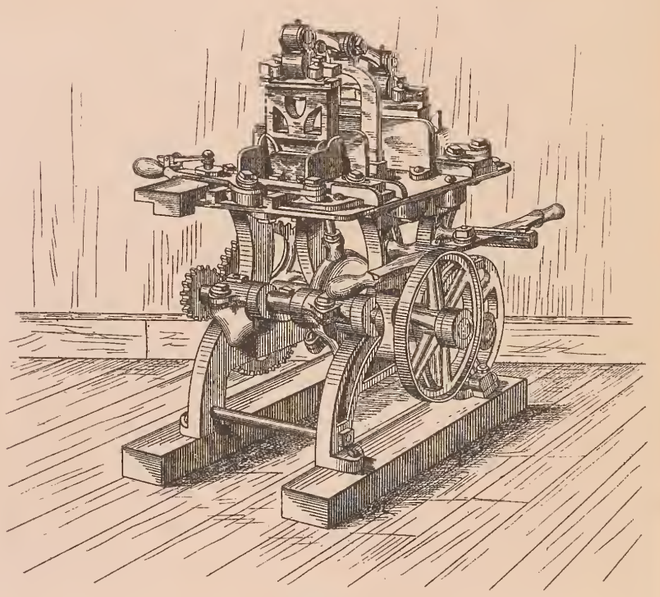
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TOBACCO PRESSES.

TOBACCO PRESSES

No. 1. U. S. Patent, Pressing Rolled Tobacco—A. D. 1837.
2. " " Pressing Tobacco into Hogsheads—A. D. 1841.
3. " " Hydraulic Press—A. D. 1858.
4. " " Plunger Press—A. D. 1866.
5. " " Double-acting Toggle Levor Press—A. D. 1868.
6. " " Tobacco Press—A. D. 1873.
7. " " Compressing into Hogsheads—A. D. 1877.
8. " " Plug Tobacco Compressing—A. D. 1882.
9. " " " " " —A. D. 1884.

One of the commonest of the primitive methods of tobacco manufacture, was to take a bundle of leaves of about the same length and make of them what was known as the "tobacco twist." The process was simple, and was done mainly by hand. Later, a rude press, consisting of a pedestal, above which an iron or wooden screw was suspended, was used for compressing this twist into smaller bulk.

After presses were used for the twist, it became apparent that what is known as the "plug chewing tobacco" could be compressed into still smaller space. For this purpose long flat boxes were manufactured; the tobacco was made into long loose rolls; these rolls contained the dark, richer leaves, but were enclosed in large, bright-yellow leaves, which still bring a high price in the market, and are designated as "wrappers." These rolls are then placed in the flat boxes and the screw above the pedestal is lowered upon them at immense pressure. The screw remains stationary at this high pressure until the large roll becomes pressed into the shape of the flat box, and is then sold as a plug. Many hundreds of these plugs are packed in wooden boxes. These boxes, before the tops are nailed on, are placed on the pedestal of the tobacco press, and again subjected to the pressure of the screw. This second pressure causes the plugs to press closely upon each other, and when they are taken out by the retail tobacconists they sometimes stick together like leaves of mica. As soon as a box of plugs comes from the press it receives the internal revenue stamp of the United States.

These stamps are rightly prefixed by the word "revenue." They are a source of very great revenue to the Government, and are the main causes of the surplus now in the Treasury.

The tobacco tax at this date is $20,000,000, and about one-third of this is paid on the tobacco which goes through the presses.

Like every other invention the tobacco press has been subjected to a variety of improvements.

The original press was a small wooden screw, worked by a wooden lever. Then followed the iron screw and iron lever. Afterwards the power of the press was greatly increased, and horse-power was employed. Steam soon succeeded horse-power, and now great manufactories in New York, Detroit, Toronto, Chicago, and Durham, N. C., turn out more work in an hour by the aid of steam than the primitive press could do in a month.

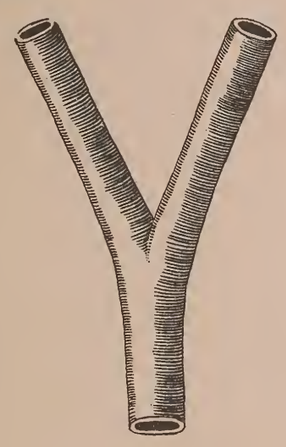
Durham, North Carolina, does the largest tobacco manufacturing business in the world. The town is in the center of the golden tobacco belt. The town sprang up as if by magic; it owes its prosperity to the tobacco trade alone.

One of the wisest pioneers of the tobacco trade in that section was the late Robert A. Jenkins, Esq., who had on hand over 1,000,000 pounds of the golden tobacco at the close of the war. He knew the value of the tobacco grown in that section, and advertised it throughout the North by selling great quantities to the soldiers of General Sherman's army on their march to the sea.

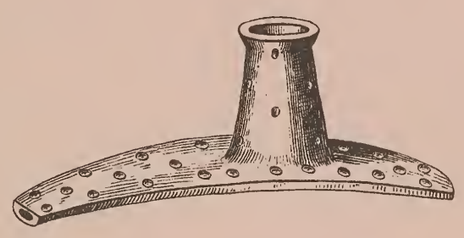
TOBACCO PRESSES.

115 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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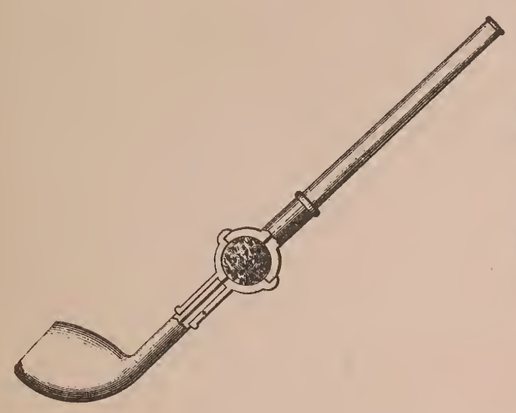
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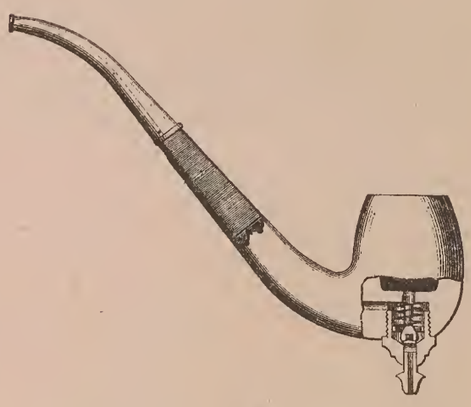
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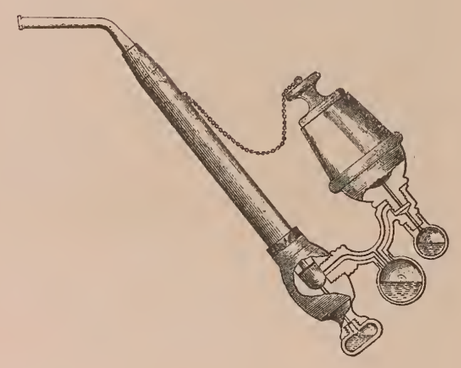
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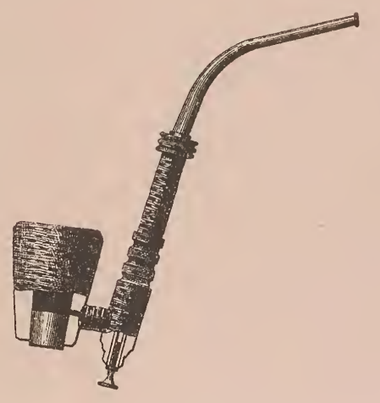
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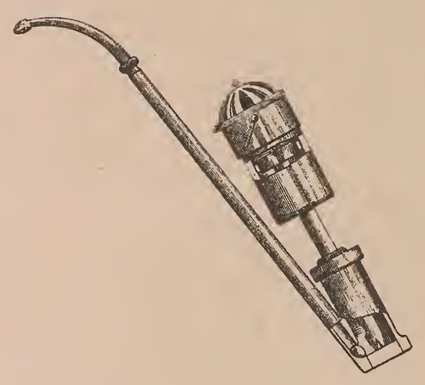
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TOBACCO PIPES.

TOBACCO PIPES.

No. 1. Primitive Hispanolia Inhaling—A. D. 1547.
2. " Mound Builders.
3. " Indian Clay.
4. " Brazil—A. D. 1590.
5. Types—Indian, Turkish, American, Dutch, African.
6. U. S. Patent, Sponge Chamber—A. D. 1858.
7. " " Detachable Perforated Holder—A. D. 1862.
8. " " Nicotine Chamber—A. D. 1866.
9. " " Nicotine, Water & Saliva Cup Attachment—1870.
10. " " Combined Pipe and Cigar Holder—A. D. 1871.
11. " " Corn Cob—A. D. 1878.
12. " " Movable Bottom—A. D. 1883.
13. " " Movable Bottom—A. D. 1884.

The sailors sent ashore by Columbus, at Cuba, found, to their astonishment, the natives puffing smoke from their mouths and noses, which, they afterwards learned, was derived from the combustion of the dried leaves of a plant. The smoke was inhaled through a hollow cane, one end of which was introduced into the mouth, or, in case of this being forked, the forked ends were inserted in the nostrils and the other end was applied to the burning leaves.

The Aztecs, in Mexico, used pipes of varnished and richly gilt wood.

Pipes, made of clay, were used by the native Indians of Virginia, in 1585.

The Colonists introduced into England the practice of tobacco smoking, or, as it was first called, "tobacco drinking." The first method of imbibing the fumes was by means of a walnut shell and a straw.

Sir Walter Raleigh and other young Englishmen, gave every encouragement to tobacco smoking.

The Calumet pipe of peace of the North American Indians was of red, black or white stone, finely polished. The stem was about two and one-half feet long, of strong reed or cane, adorned with feathers of different colors. This pipe was a safe conduct among the allies of the tribe which gave it, and in all embassies the embassador carried it as a symbol of peace.

The dying Gavarni said to his friend, "I consign my wife to your care, but oh, do take care of my pipe."

Pipes have been made of formidable dimensions in Germany, some carrying a quarter of a pound, others half a pound, and even a pound of tobacco. They figure in the shops of Bremen and Hamburgh. Some large and fine specimens of meerschaum are carved so elaborately into pipe bowls as to command two or three hundred guineas each. But all these giants of smokedom, "pale their ineffectual fires" before the monster pipe of the South American Indians, the pipe of the tribe of Oyatopoks. It remains burning night and day, filled with a species of herb, which they use instead of tobacco. This huge pipe is surrounded at one time with a hundred to a hundred and fifty aspirants, who fix their long tubes of reed into the numerous holes with which its sides are bored.

Tobacco pipes are made of a finely ground white plastic clay called "pipe clay." This clay being worked into paste and dough, in the same manner as the finer sorts of potter's stuff, is next rolled into cylinders for the stems, and into balls for the bowls. These are then pressed to the desired form in metallic molds and pierced with a wire, dried for a day or two, scraped, polished, dipped, and ultimately fired in a baking kiln for ten or twelve hours. A clever workman aided by a boy, can make from five to six gross of plain pipes per day.

Almost every material has been fashioned into pipes—stone, wood, bronze and other metals, bone and clay of every kind, including, of course, the fashionable meerschaum, which is, after all, only a species of clay, called magnesite, which is the mineral magnesium silicated, or in union with silex or flint,

It is estimated that 54,000 genuine meerschaum bowls or heads are annually produced in Germany, and about 9,600,000 of the common porcelain, the favorite of the German peasantry, and of those of fine clay or lava 2,700,000 are manufactured yearly.

TOBACCO PIPES.

37 Manufactories in the United States.

	1870	1880
Capital Invested,	$178,600.00	$233,800.00
Value of Productions,	477,330.00	628,688.00
Wages Paid,	214,924.00	226,306.00
Hands Employed,	481	645

170 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



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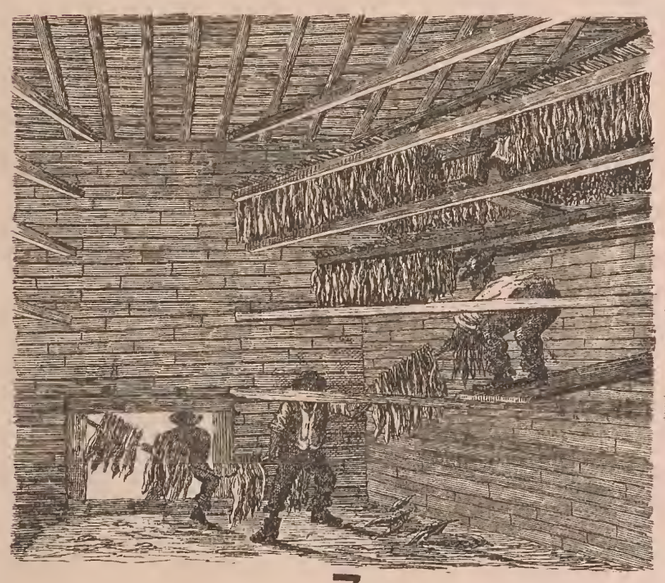
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TOBACCO--HAND CULTURE AND TREATMENT.

TOBACCO—HAND CULTURE AND TREATMENT.

No. 1. Sowing Seed.
2. Hilling.
3. Transplanting.
4. Laying by and Topping.
5. Worming and Suckering.
6. Cutting and Sticking.
7. Housing.
8. Stripping and Tying.
9. Packing.

The name tobacco is supposed to be derived from the Indian tabacos, a name given by the Caribs to the pipe or tube in which they smoked, or inhaled the smoke of the plant. Others derive it from Tabasco, a province of Mexico. Others from the island of Tobago, one of the West Indies. The name of the genus is derived from that of the French ambassador to Portugal, Jean Nicot, who brought some tobacco in 1560 from Lisbon to France, and who stated that "the seeds were those of a highly valuable medicinal plant introduced into Portugal in 1520." The plant was unknown to Europeans until the discovery of America, when it was first noticed by sailors sent ashore by Columbus in Cuba.

Tobacco was very generally met with as other portions of America were discovered.

Garcilasso speaks of the ancient Peruvians as using it only for medicinal purposes, in the form of snuff.

Tobacco is successfully cultivated throughout a wide range of latitude. Excellent varieties are produced in the equatorial regions, and in the United States its limits are not quite reached at the borders of Canada. The plant requires a deep, rich, mellow soil, or sandy loam.

The method of raising the plants is as follows: The seeds having been sown in beds and germinated sufficiently, are picked out, as soon as they are able to be handled, and allowed to gain five or six leaves (exclusive of the seminal leaves.) They are then transplanted, during the month of May, into fields which have been previously much manured. The plants are placed two or three feet apart, in rows. The roots have a tendency to appear above ground; the earth, is, therefore, from time to time heaped around them; when nearly full grown, the tops are pinched off to prevent development of flowers and seeds, and to promote the growth of leaves. The harvest generally takes place in August. The mature plants are cut off above the roots, placed in heaps under cover, and allowed to sweat for three or four days, after which they are hung in airy sheds to dry. They are then submitted to a similar process for one or two weeks, and then, when slightly moist, the leaves are stripped and packed for market.

The production to the acre is usually from 600 to 700 pounds.

TOBACCO—HAND CULTURE AND TREATMENT.

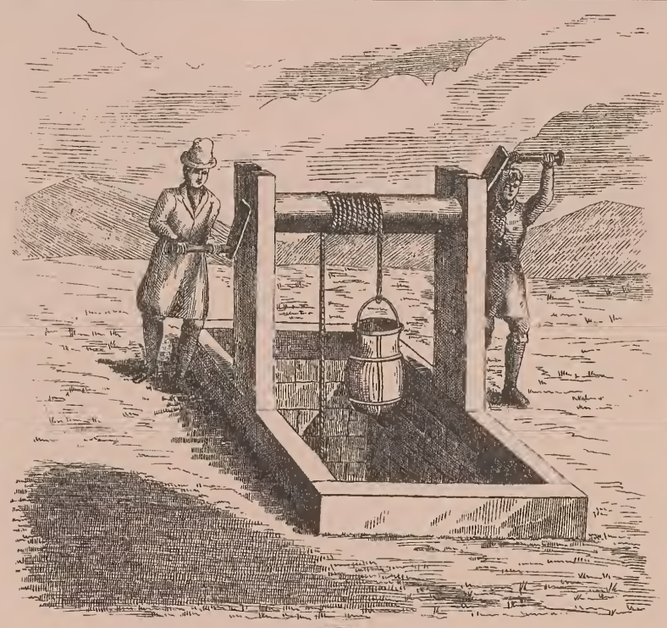
	1860	1880
Area in Acres,	Not reported.	638,841
Pounds raised,	434,209,461	472,661,158

84 Patents Granted by the United States.

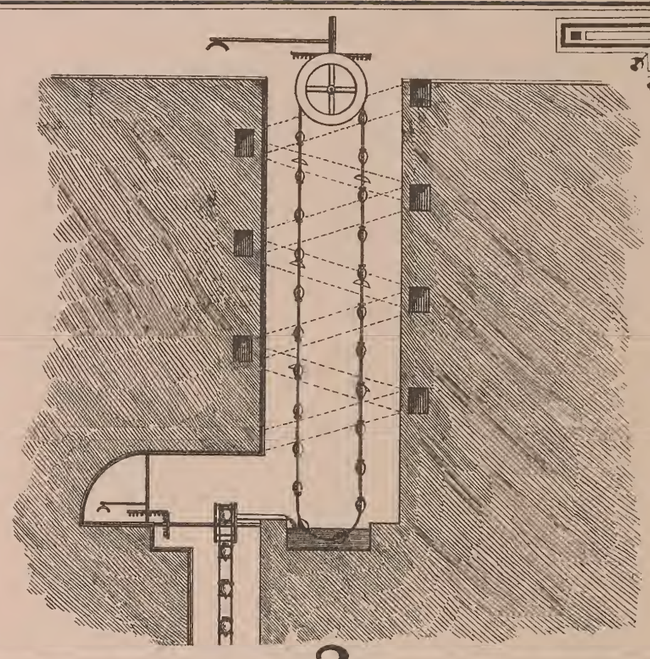
Sackett & Wilhelms Litho Co New York



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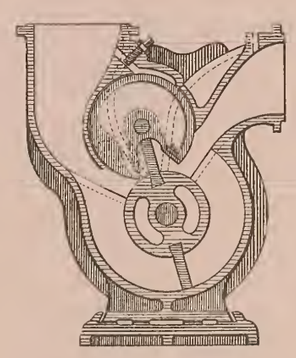
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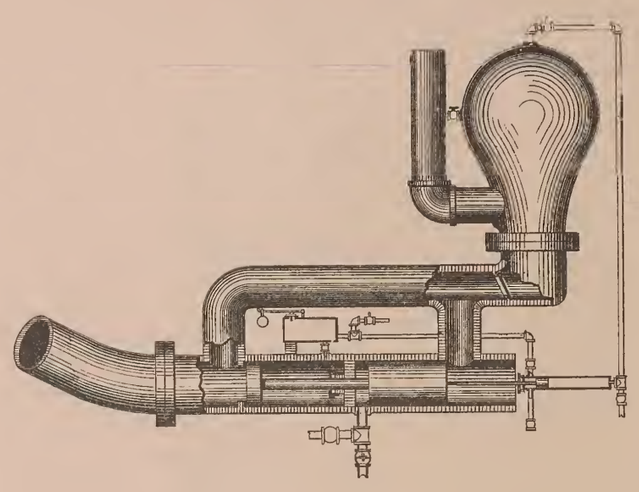
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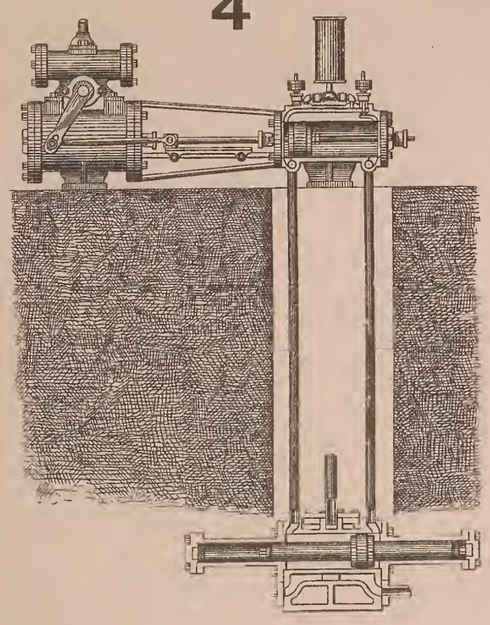
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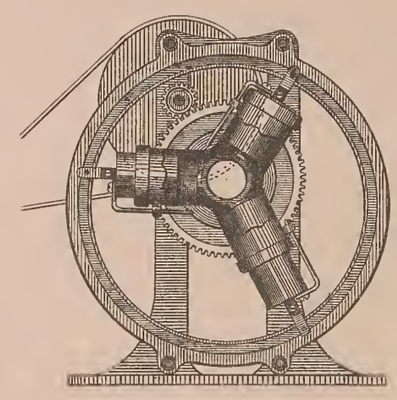
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9

WATER ELEVATORS.

WATER ELEVATORS.

No. 1. Primitive, Raising Water, Asia.
2. " " " Roman.
3. " Chain Buckets.
4. " Atmospheric Bellows Pump.
5. U. S. Patent, Rotary Pump—A. D. 1874.
6. " " Water Elevator—A. D. 1879.
7. " " Transmitting Power—A. D. 1881.
8. " " Force Pump—A. D. 1883.
9. " " Rotary Pump—A. D. 1884.

The earliest water elevator machine is found represented on a monument of as early date as 1432 B. C. Something similar to this is still used on the banks of the Nile.

Wilkinson says that an instrument resembling a portable pump is represented in the sculptures of the ancient Egyptians.

The contrivances of the Asiatics for raising water are wheels furnished with buckets upon their peripheries.

The pole and bucket are of the most ancient as well as of modern use. So also is the Archimedean screw.

Siculus says "the Egyptians have an easy way to water the land by means of an engine invented by Archimedes, the Syracusan, which from its form is called 'Cochlea.'"

The "Jantee" is another water raising device of great antiquity used in Bengal for land irrigation. It is a trough counter-weighted by an extended arm and balanced across a bar. As the trough end descends it dips water, and as it rises the water runs towards the axis of vibration and escapes at a lateral orifice into a trough which conducts it to the field.

The history of the hydraulic pump cannot be clearly traced. The ancient Egyptians and Assyrians used endless ropes moved by drum wheels with buckets attached.

The chain pump was first used by the Chinese.

The representation of a machine resembling a public pump is often seen in Egyptian sculpture.

The invention of the valve pump is ascribed to Ctesibius, of Alexandria, third century B. C.

There is no evidence of the employment of a valve pump prior to the Christian era.

The invention of the hydraulic ram is ascribed to the elder Montgolfier, and its improvement to the son. The principle, however, was previously employed by John Whitehead, of England, in a machine constructed by him in 1772. The principal difference between his machine and Montgolfier's ram consisted in the use of a stop cock in place of the automatic impulse valve.

The clearer comprehension of the science of hydraulics has given to this generation a more extended knowledge over water power. Hydraulic elevators are constantly being exhibited and patented. The one known as the "Acenseur Edoux" is considered the safest of all methods of raising great weights by hydraulic pressure, and is remarkably smooth and noiseless in action. Preference is also given to the "Acenseur Edoux" on account of its avoidance of the use of a lifting cable.

In England companies are now established for the renting of hydraulic power distributed by mains.

The hydraulic pressure pump is used for working a hydraulic press.

An invention known as "Knowles' pump" works directly from the steam cylinder, dispensing with belt, pulley, cranks and fly wheel.

The modern hydraulic ram is another powerful water raising device. The span of Rock Island draw bridge is rotated by two hydraulic rams. The power of the rams is transferred to the pier by a wire rope arranged as an Armstrong crane.

The hydrometer is a portable force pump for sprinkling gardens, flowers, &c.

An aquapuit is another portable force pump for similar purposes.

The ordinary atomizer may be classed under the head of atmospheric pumps.

The rotary pump acts by a rotary, in contradistinction to a reciprocating, action. Rotary pumps are of various kinds, single and double pistons and centrifugal.

In the Douglass rotary pump the pistons are three in number, and are operated by a scroll race in which the rollers of the pistons are held against the under diameter of the cylinder in which they work, and withdrawn to pass the abutment. Passages through the slides balance the water pressure on their respective sides.

Samain's pump is also rotary. In Bayley and Sewall's rotary pump an eccentric ring rotates the cylinder.

Inventors in all parts of the world have experimented on water power by means of this rotary motion.

A Russian, Greindl, has invented a very valuable rotary pump.

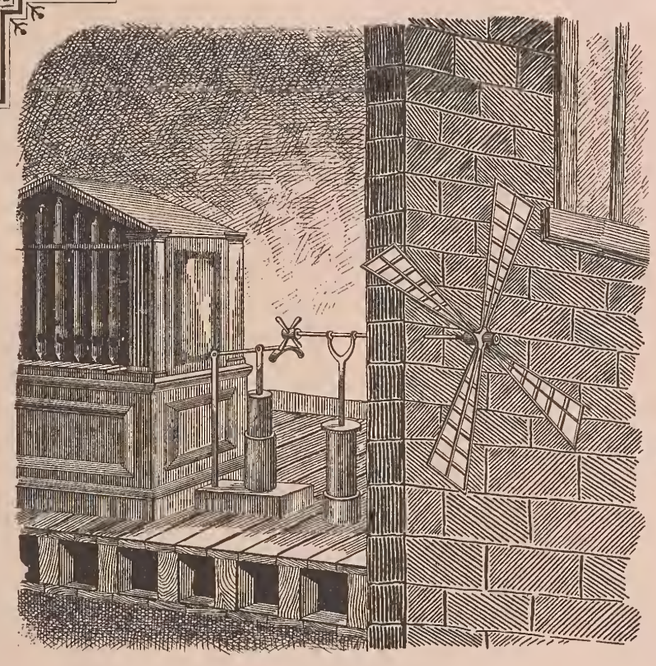
A chain bucket is the valve on the chain of the pump. It is elastic, fills the pipe in ascending, and lifts and discharges the water.

The chain pump is one in which buckets are attached to a continuous chain. Murray's chain pump is especially adapted for hydraulic construction, drainage, sewerage works, &c., having no valves to be obstructed by mud, sand or wheels.

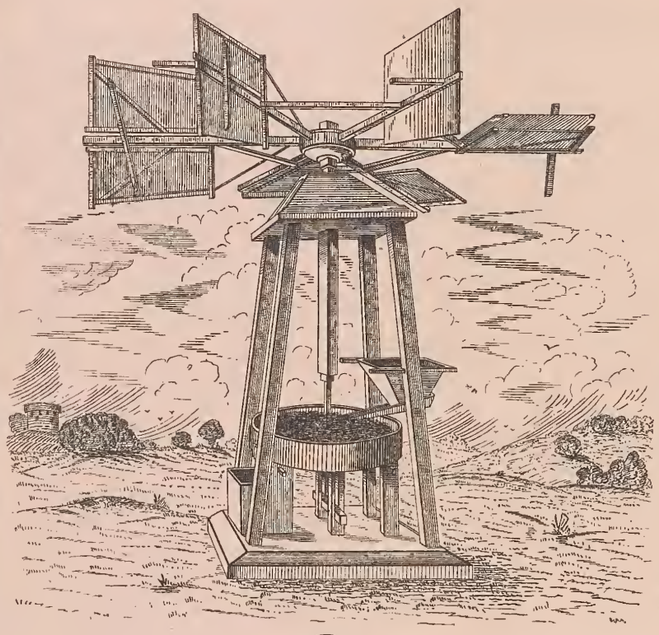
WATER ELEVATORS.

2,737 Patents Granted by the United States.

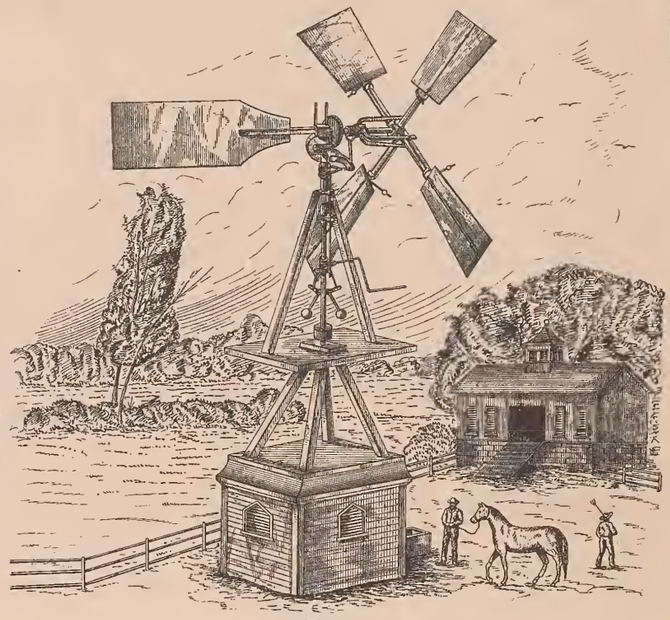
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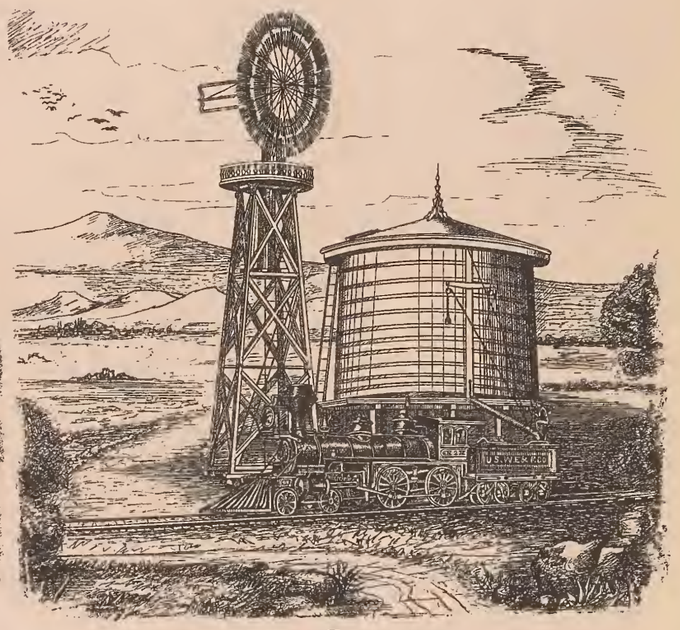
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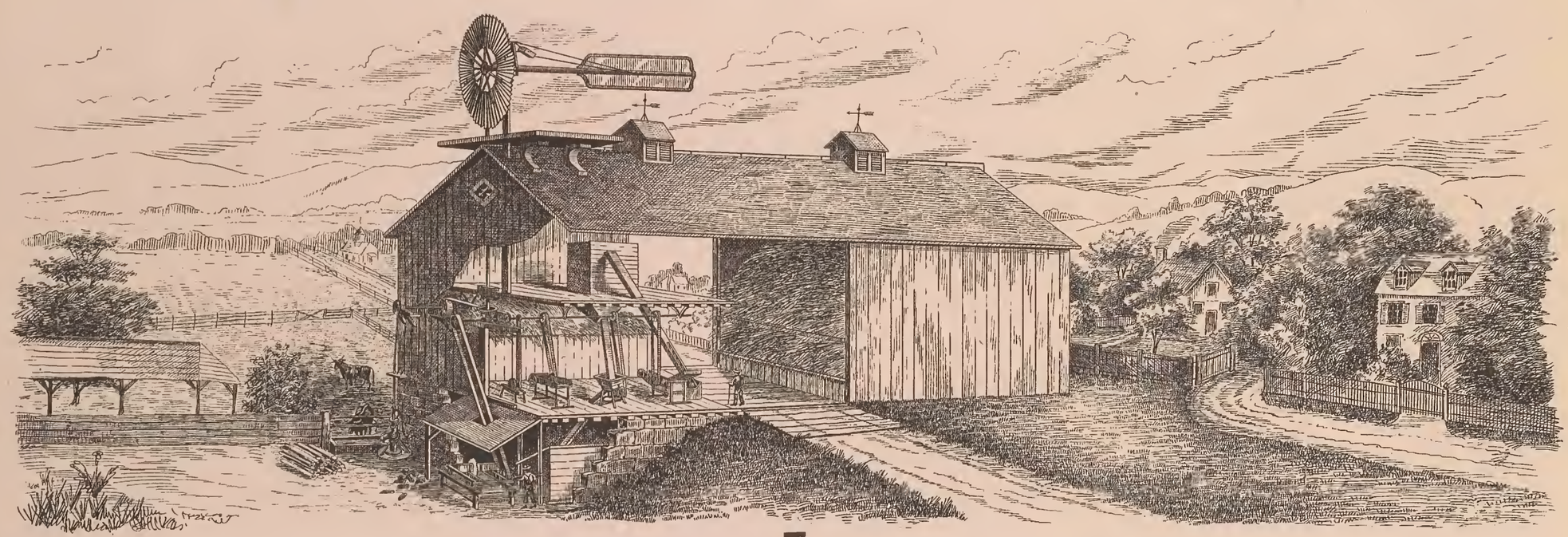
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7

WINDMILLS.

WINDMILLS.

No. 1. Primitive—B. C. 150.
2. Horizontal Wheel—A. D. 1719.
3. U. S. Patent, Vertical Wheel—A. D. 1859.
4. " " Geared Vertical Wheel—A. D. 1873.
5. " " Hoisting—A. D. 1882.
6. " " Pumping Railroad Tank—A. D. 1883.
7. " " Farm—A. D. 1883.

Paulo introduced windmills into Rome for grinding grain a little before the time of Augustus.

In the time of Hero, 150 B. C., organs were blown by the agency of a windmill, which worked the piston of an air pump.

They were used in England A. D. 1180, and from the twelfth to the fourteenth century notices of them are common.

Bartolomeo Verdi had a grant of land to build windmills, in Venice, in 1332.

In the twelfth century the Pope decided that the usufructs of water and windmills were taxable.

Those which turn wholly round are the most ancient.

The first mode adopted to present the vanes towards the wind was to float the mill and turn it in the water as occasion required.

The next was to put it on a post, and turn the building on this as an axis. This was called the German method. Then followed turning the cap or roof, which was a Dutch invention of the sixteenth century.

In 1772, Andrew Meikle, of Scotland, invented a plan for automatically adjusting the area of the sails to the force of the wind.

In 1804, Bywater, of England, patented a method of rolling up the sails to adjust them in like manner, by means of a weighted lever which was caused to operate gears connected by cords to cylinders on which the sails were wound.

The ball governor, from which Watt borrowed the idea, was first used in windmills.

In Holland windmills are employed in driving the scoop wheels which drain the polders.

Holland has over 12,000 windmills in operation, averaging eight horse power.

In many portions of the United States, especially in low countries where they have no water power, windmills are used for driving machinery, for thrashing and grinding grain, and for pumping water.

There are several large establishments in the United States for manufacturing machinery for windmills.

In the low lands along the Southern Atlantic coast windmills are used by the planters for driving the machinery of the rice and sugar mills.

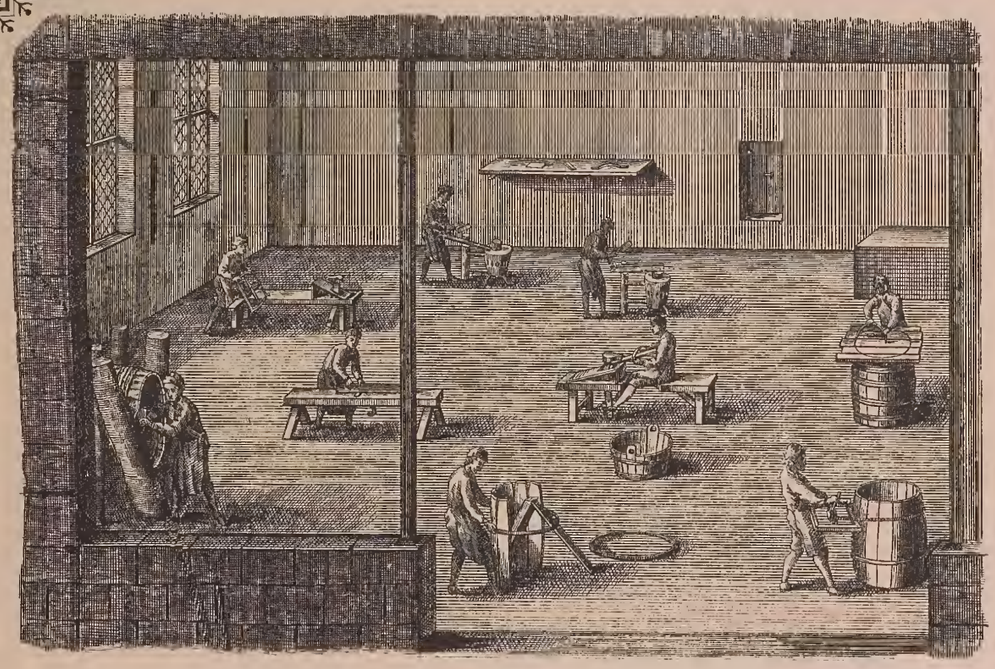
WINDMILLS.

69 Manufactories in the United States.

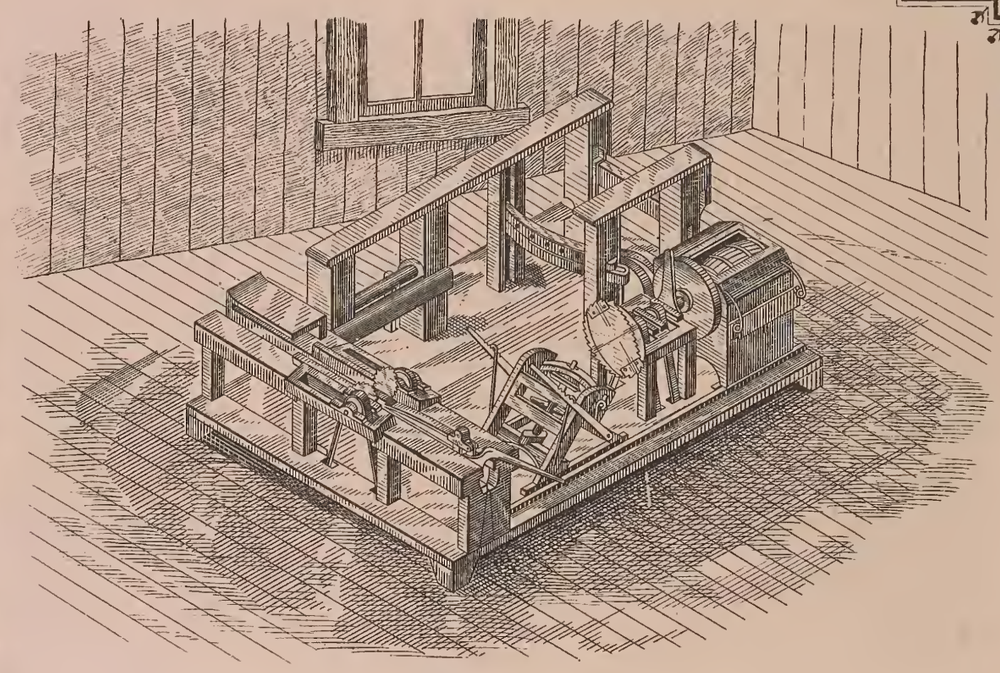
	1860	1880
Capital Invested,	$8,550.00	$697,100.00
Value of Productions,	28,750.00	1,010,542.00
Wages Paid,	12,948.00	244,197.00
Hands Employed,	27	596
CAPACITY—		Present Machine.
Maximum gallons Water pumped per day,		450,000
Hands employed per day,		1

908 Patents Granted by the United States.

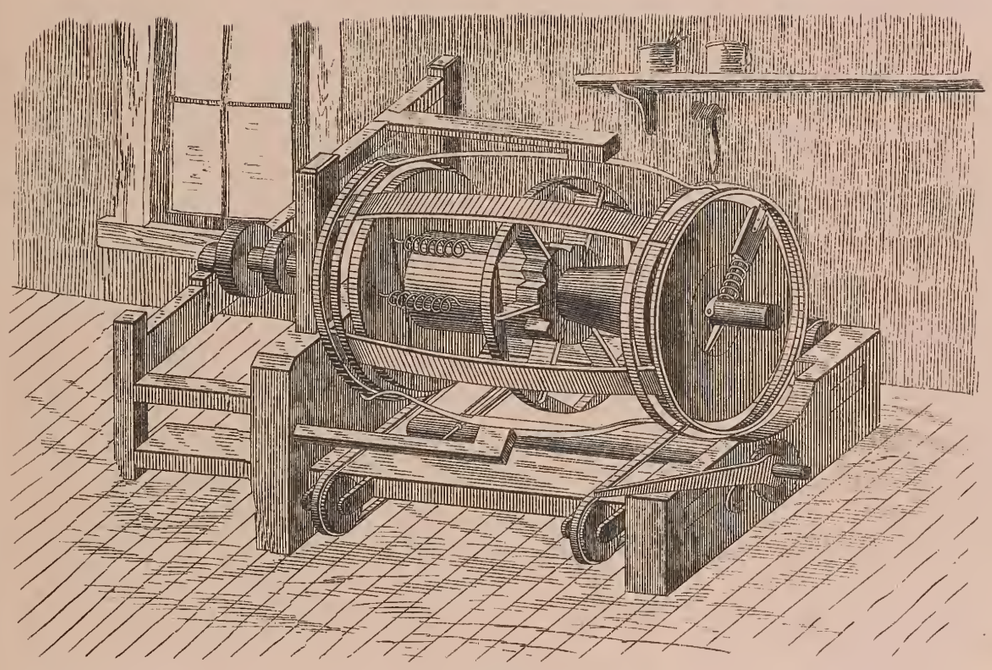
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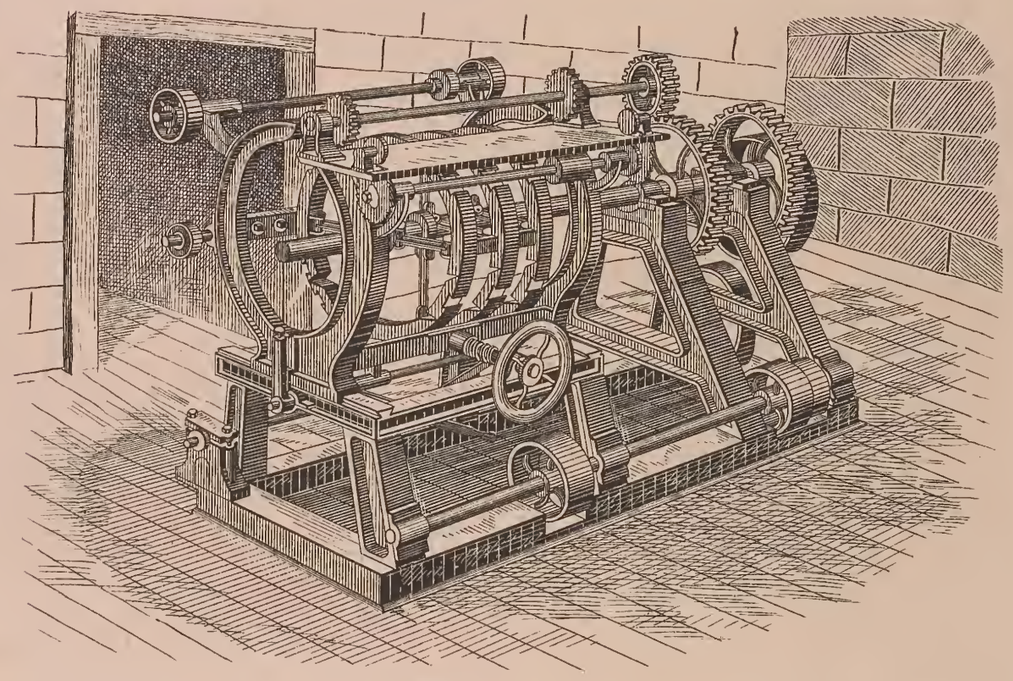
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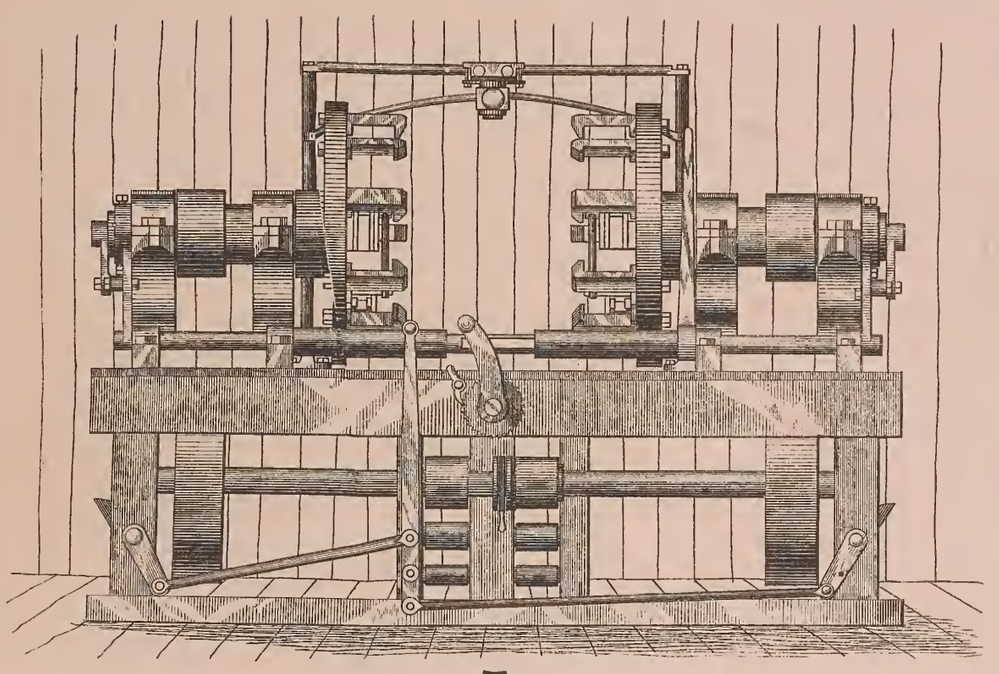
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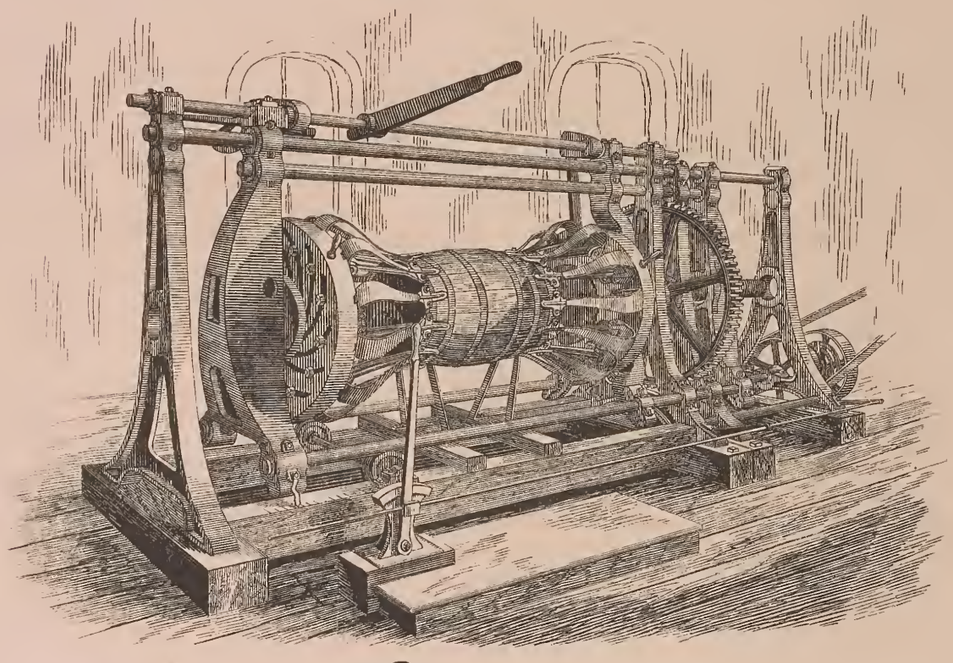
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WOOD WORKING--COOPERING.

WOOD WORKING---COOPERING.

No. 1. Primitive Coopering—A. D. 1776.
2. U. S. Patent, Barrel Stave Machine—A. D. 1844.
3. " " Barrel Crozing Machine—A. D. 1858.
4. " " Barrel Making Machine—A. D. 1883.
5. " " Barrel Crozing Machine—A. D. 1883.
6. " " Barrel Crozing Machine—A. D. 1883.

The monuments of Egypt furnish proof of the early use of hooped vessels, though no date is given of their invention.

In one of the inscriptions copied by Wilkinson may be seen two slaves emptying grain from a wooden vessel made with hoops.

Throughout the East the bamboo is largely used for making hollow vessels, a section of the stem through a node securing a solid bottom, and one between the nodes an open mouth for a natural tub or bucket.

In well-wooded regions nothing would be more natural than the employment of hollow tree trunks for the same purpose, or sections of tree stems hollowed out by fire or otherwise.

In drying, such vessels would split and spoil, and it would require no great genius to repair them by means of withes or wooden bands, the primitive form of the hoop.

The fabrication of casks was early introduced into France, and from that country was carried into Britain.

The occupation of the modern cooper is divided into distinct branches, as the dry, the wet or tight, which are again subdivided into large and small work.

Hoops for casks are known as bilge chine or chime, flat, half round, quarter and truss.

The Standard Oil Company is constructing at Pittsburg a factory for the manufacture of barrels for its own use. The building will be 300 feet square, and supplied with the latest improved machinery for making barrels, with a capacity for turning out 5,000 to 7,000 barrels a day.

WOOD WORKING---COOPERING.

438 Patents Granted by the United States.

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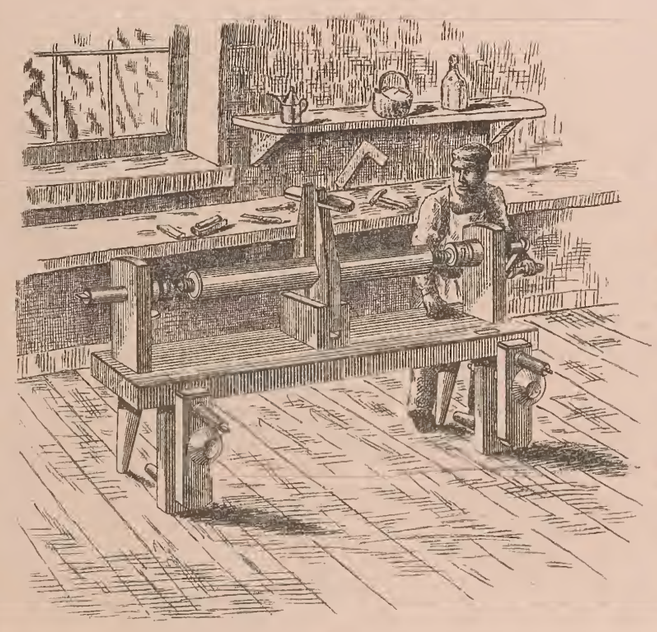
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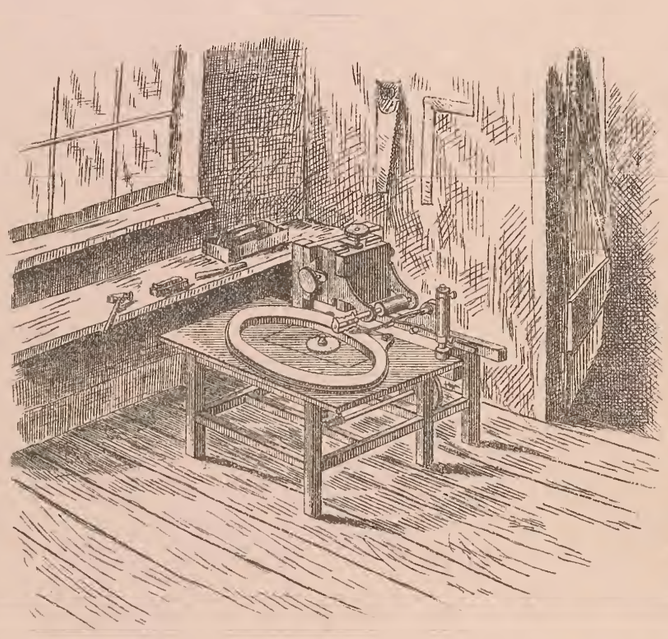


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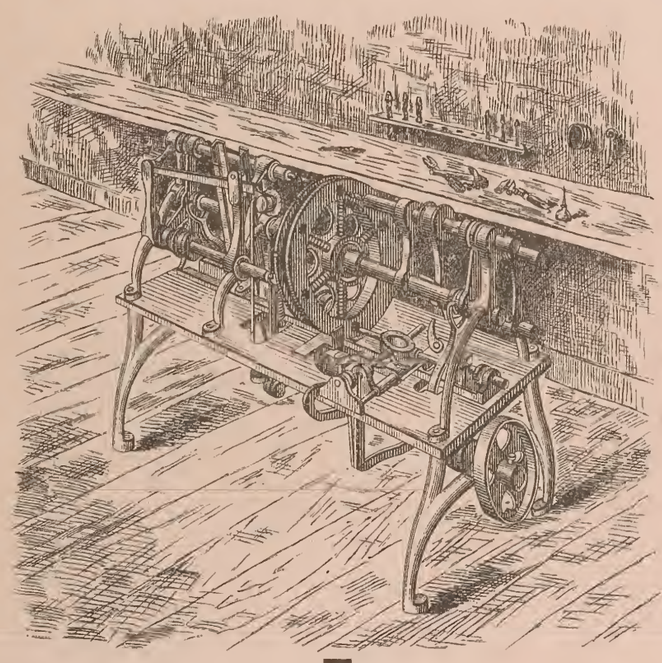
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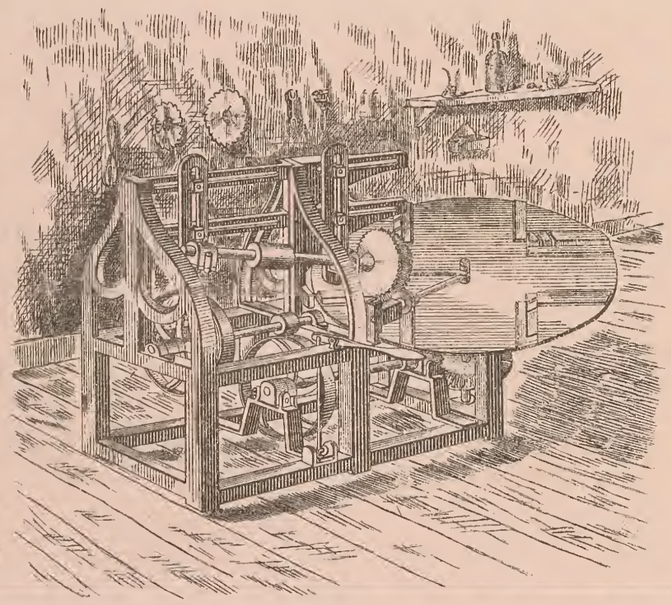




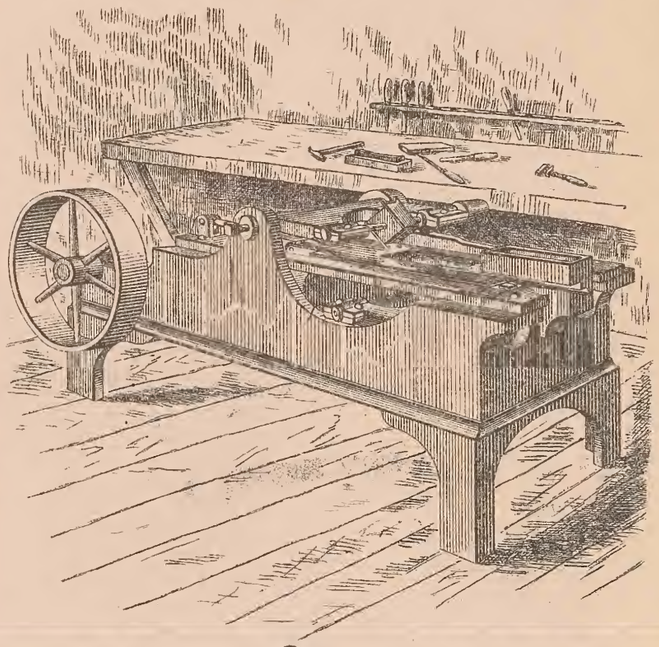
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WOOD WORKING--MOLDING.

WOOD WORKING---MOLDING.

No. 1. Primitive Gaining Machine—A. D. 1775.
2. " Molding Machine—A. D. 1775.
3. " Dressing Ballusters—A. D. 1775.
4. U. S. Patent. Wooden Screw Machine—A. D. 1816.
5. " " Oval Frame Machine—A. D. 1862.
6. " " Shaping Chair Stuff—A. D. 1869.
7. " " Bobbin and Spool Machine—A. D. 1876.
8. " " Felly Machine—A. D. 1880.
9. " " Wedge Machine—A. D. 1884.

Professor Willis states that "Gen. Benthem's house was converted into and formed the first manufactory of wood-working machines, including planing, molding, rabbeting, grooving and mortising machines."

The wood-molding machine is analogous to the carving machine.

It is said that Berlin, Germany, has become the headquarters of the carved wood industry. Six hundred artists in wood carving, the same number of turners, and 700 carpenters, are engaged in manufacturing such articles as cigar cases, newspaper and picture frames, napkin rings, &c. The value of the annual export of these articles is 5,000,000 marks, and this is exclusive of the costly carved wood furniture, the manufacture and export of which is assuming large proportions.

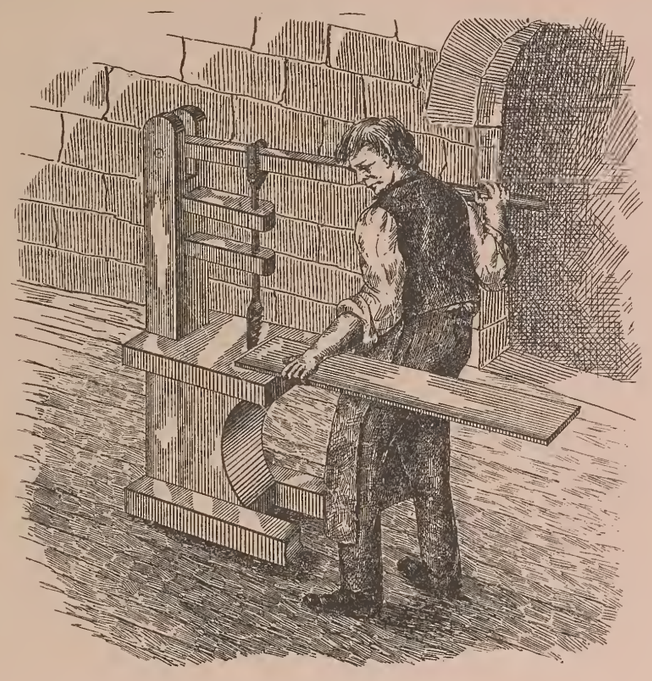
Since 1850 the inventions in wood-working machines have followed each other in rapid succession in the United States. Within the past few years the art has been raised to the dignity of recognition among other branches of engineering.

Machines for molding and planing wood are of every conceivable arrangement and capacity, from the surface planer of two feet in width, to the milling cutter, three-eighths of an inch in diameter—consisting of not less than forty independent machines, operating with rotary cutters.

WOOD WORKING---MOLDING.

553 Patents Granted by the United States.

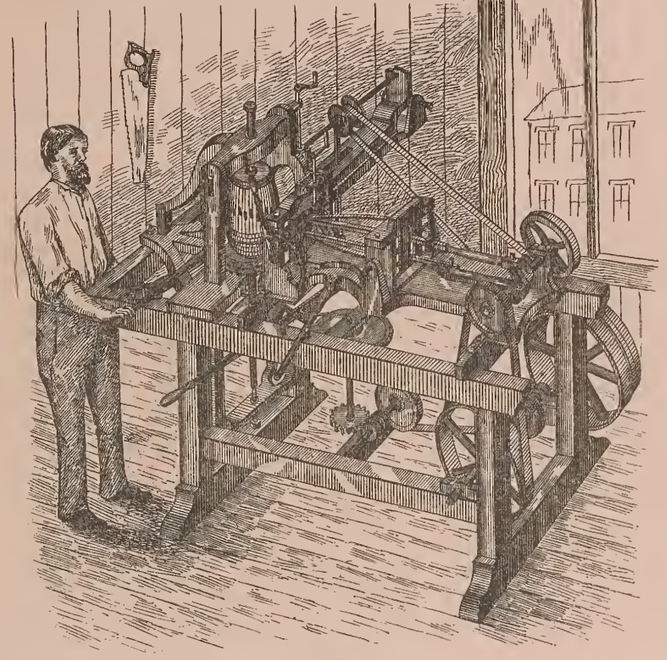
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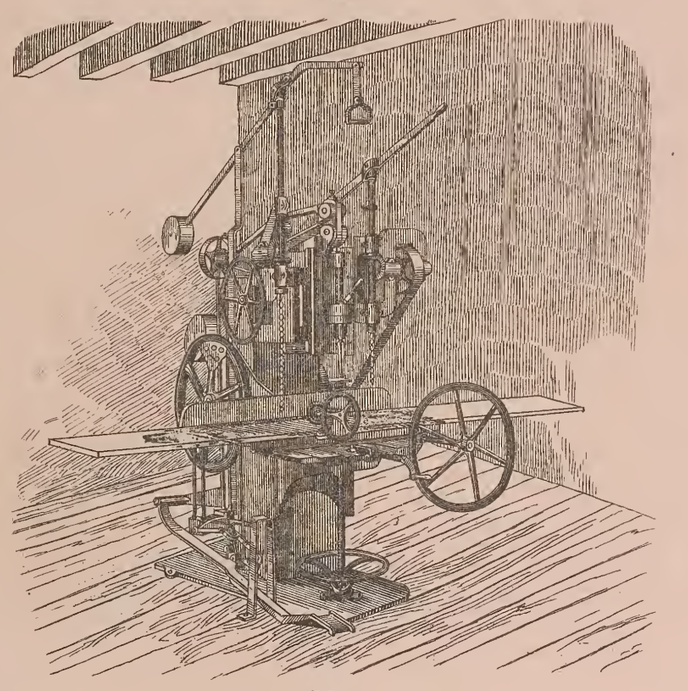
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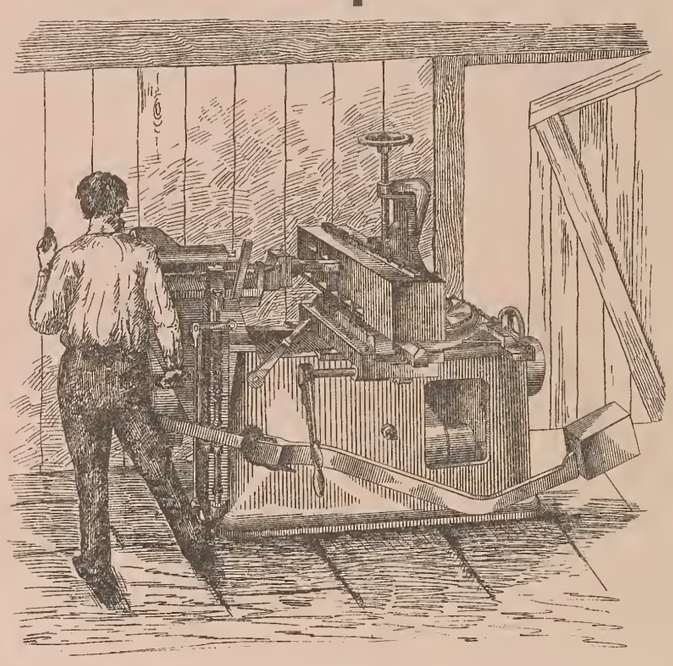
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WOOD MORTISING.

WOOD MORTISING.

No. 1. U. S. Patent, Mortising Machine—A. D. 1807.
2. " " " " —A. D. 1845.
3. " " Hub Mortising Machine—A. D. 1856.
4. " " Boring and Mortising Machine—A. D. 1876.
5. " " " " " —A. D. 1883.
6. " " " " " —A. D. 1883.

The mortising machine may have had a precarious existence before Gen. Benther's description of the self-acting machine in his patent of 1793. This included the operation by which a hole previously bored was elongated by a chisel into a slot.

Brunel's machine was made for the British Admiralty in 1804.

The mortise chisel is the invention of Brunel or Maudsley, being applied in the mortising machine invented by the former, and constructed by the latter in Portsmouth dock yard, England, in 1802–1808.

In 1827, John McClintic, of Pennsylvania, devised a practical mortising and tenoning machine.

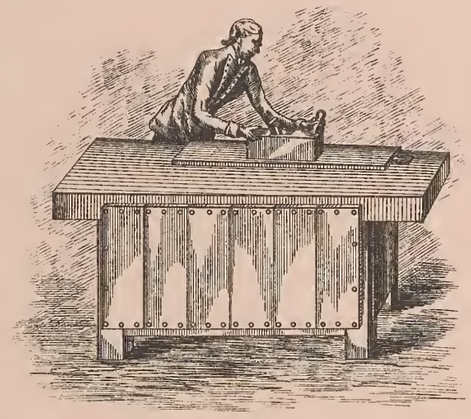
The later improvements in this class of inventions have increased their capacity and range of work.

WOOD MORTISING.

CAPACITY—	Primitive Mode.	Present Machine.
Number Mortices per day, . .	125	3,750
Hands Employed per day, . .	1	1

217 Patents Granted by the United States.

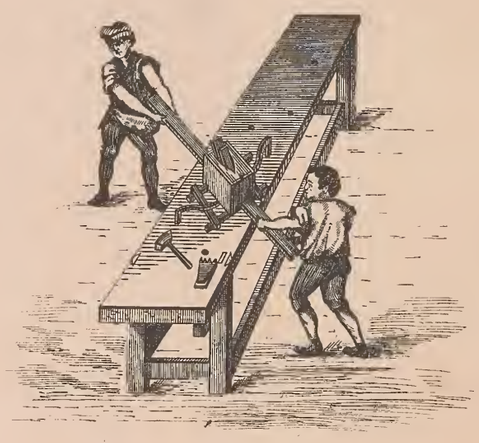
Sackett & Wilhelms Litho Co New York



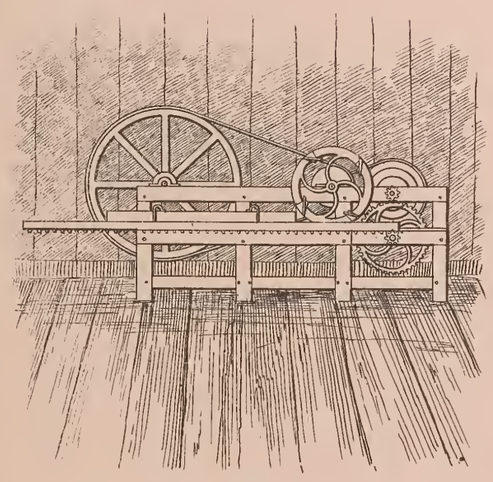
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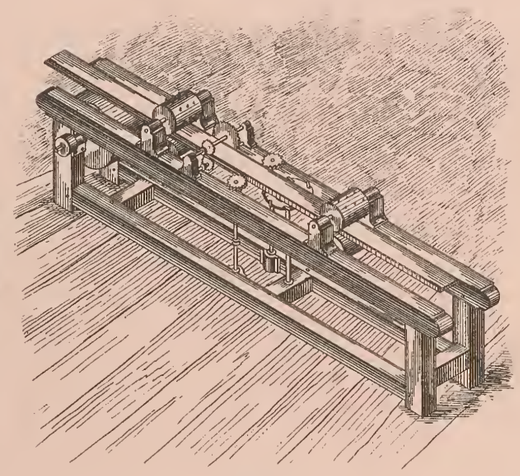
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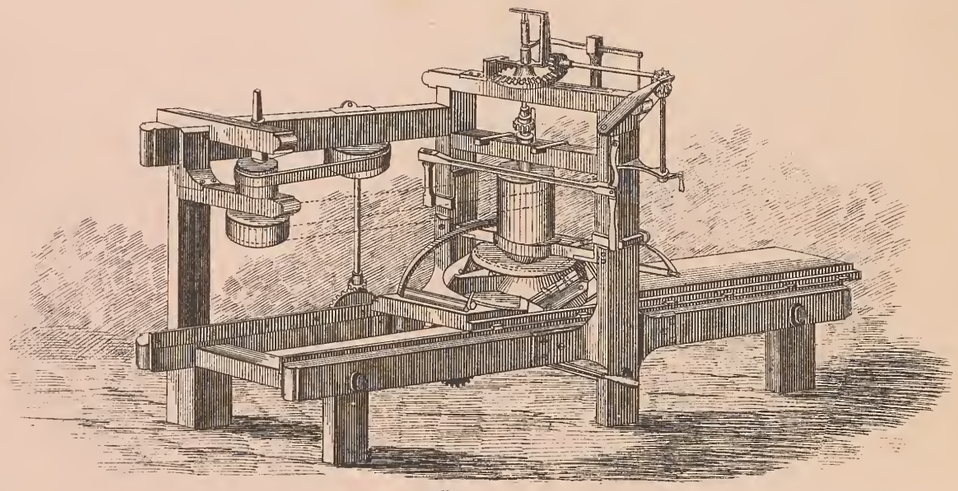
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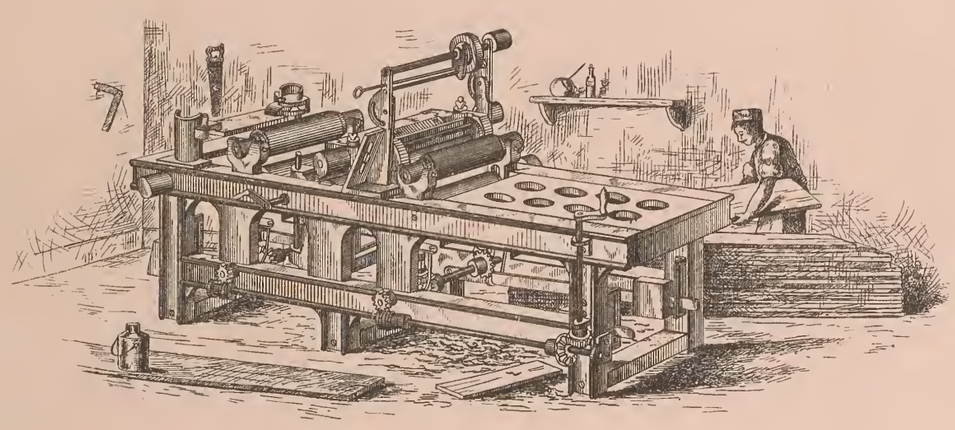
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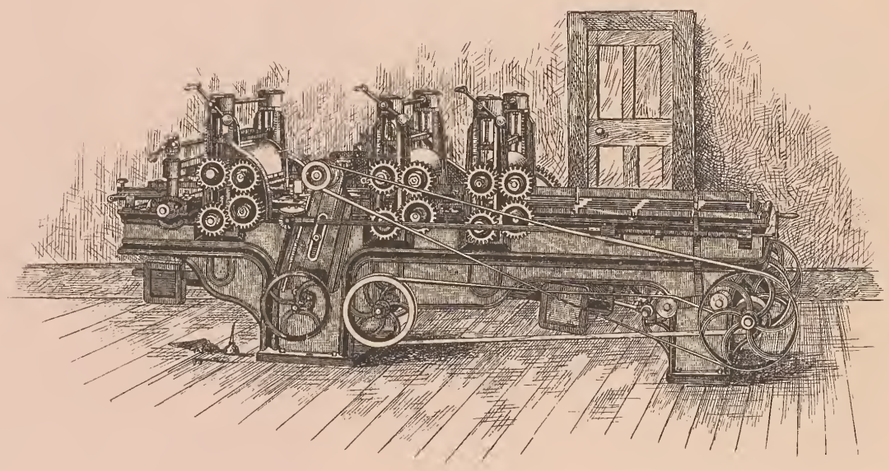
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8

WOOD WORKING--PLANING.

WOOD WORKING---PLANING.

No. 1. Primitive Bench Plane—A. D. 1775.
2. " Rabbet Plane—A. D. 1775.
3. " Planing Machine—A. D. 1775.
4. U. S. Patent, Planer, Rotary Disk—A. D. 1826.
5. " " Planing and Matching—A. D. 1834.
6. " " Planer, Rotary Disk—A. D. 1849.
7. " " " " Cylinder—A. D. 1873.
8. " " " " " —A. D. 1883.

The first to employ power in the operation of smoothing the surface of wood was Gen. Benthem, of England, and to him belongs the honor of having discovered the principle upon which all planing machines operate. He procured an English patent for his machine in the year 1791.

The transverse planing machine was invented by Bramah in 1802.

William Woodworth, of New York, patented in 1828 his celebrated planer. This patent ran for a term of twenty-eight years, being renewed twice for seven years.

In the United States a village of 2,000 inhabitants is considered large enough to support a planing mill.

Forty-five thousand feet of pine boards per day can be planed on a planing machine.

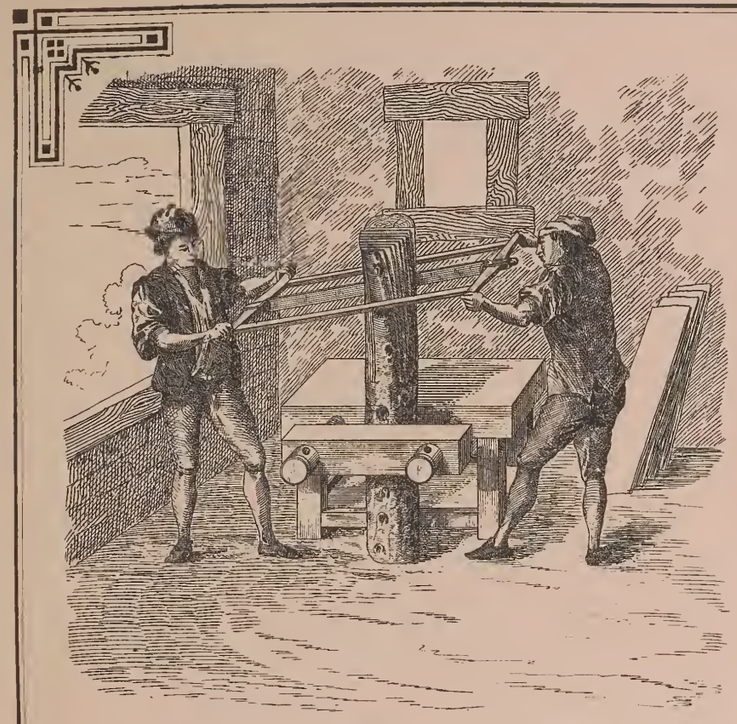
WOOD WORKING---PLANING.

4,958 Foundries and Machine Shops in the United States.

Capacity—	Primitive Mode.	Present Machine.
Feet per day, . . .	1,000	30,000
Hands Employed per day, . .	2	2

809 Patents Granted by the United States.

Sackett & Wilhelms Litho Co New York



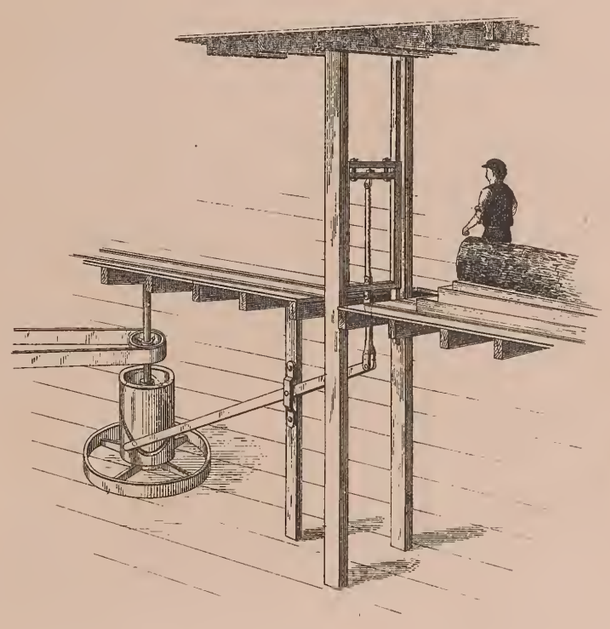
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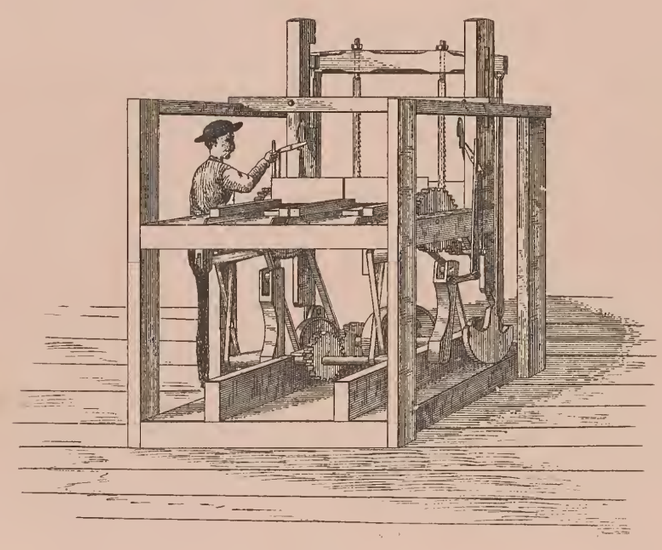
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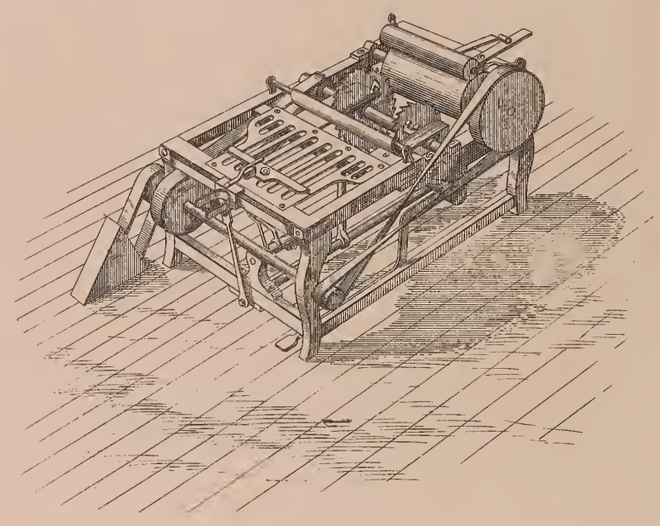
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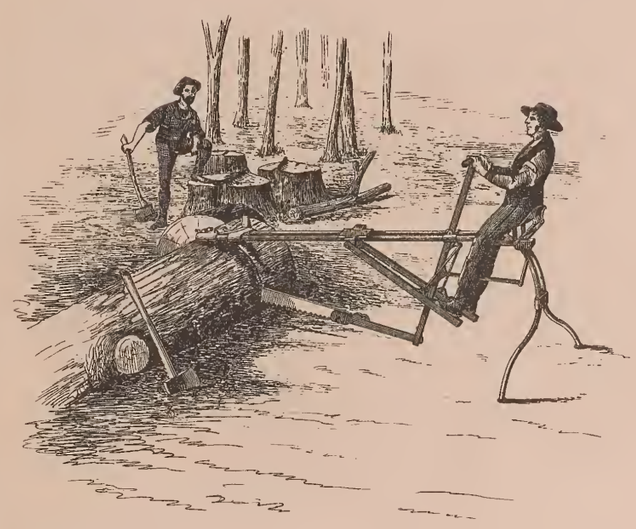
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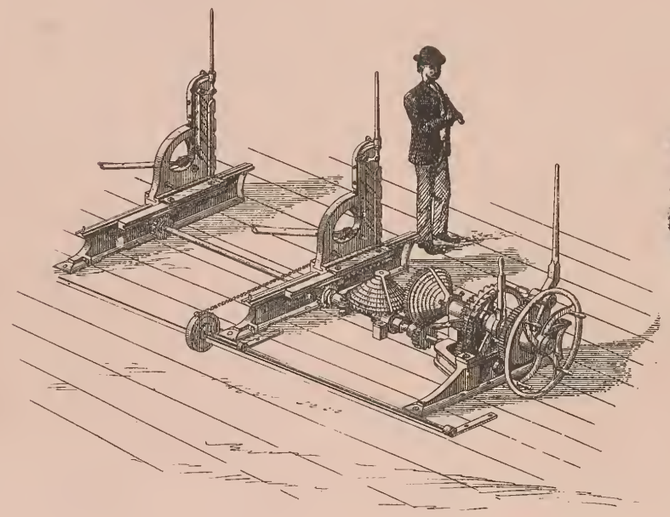
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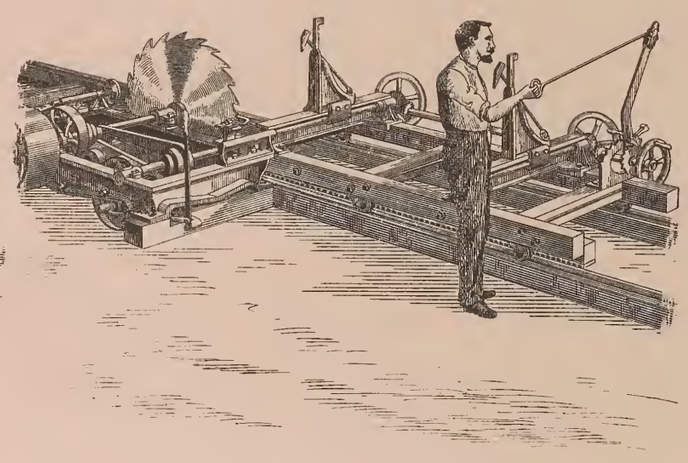
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8



9

WOOD SAWING.

WOOD SAWING.

No. 1. Primitive Sawing and Veneering—A. D. 1775.
2. " Scroll Sawing—A. D. 1775.
3. " Reciprocating Saw Mill—A. D. 1775.
4. U. S. Patent. Reciprocating Saw Mill—A. D. 1810.
5. " " " " —A. D. 1857.
6. " " Lumber Trimming Machine—A. D. 1875.
7. " " Saw Mill Head Block—A. D. 1880.
8. " " Firewood Drag Sawing Machine—A. D. 1876.
9. " " Circular Saw Mill—A. D. 1882.

Saw mills were erected in Germany in the fourth century. There was one in operation on the Island of Madeira in 1420.

The first in use in Norway was in 1530. The saw mill as a means for cutting timber was not in use very long before the settlement of America.

The first saw mill in Massachusetts is said to have been built in 1633, which was several years before it was introduced into England.

Wind saw mills were erected by the Dutch on Manhattan Island in 1633.

The populace destroyed a saw mill in England as late as 1767, fearing it would deprive the sawyers of their labors.

The first saw mill successfully established in England was in 1783.

The first in the Northwest Territory was erected in Ohio in 1789.

The earliest United States patent granted for saw mill was in 1798.

Floating saw mills are common on the lower Mississippi River. The drifting logs are picked up and turned into lumber and the product sold to the planters along the shore.

The aggregate product of the saw mill industry of the United States is reported as $233,268,729 for the year 1880.

WOOD SAWING.

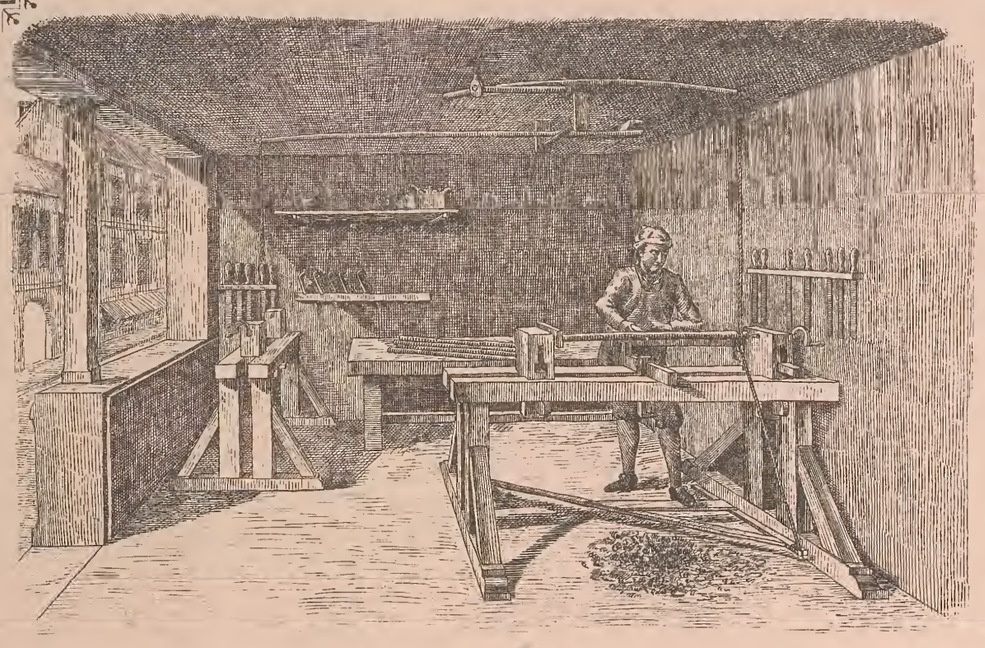
25,708 Lumber and Saw Mills in the United States.

	1860	1880
Capital Invested,	$72,503,894.00	$181,186,122.00
Value of Productions,	93,338,606.00	233,268,729.00
Wages Paid,	20,647,807.00	31,845,974.00
Hands Employed,	71,878	147,956

Capacity—	Primitive Mode.	Present Machine.
Feet per day, board measure,	4,000	100,000
Hands Employed per day,	8	8

2,975 Patents Granted by the United States.

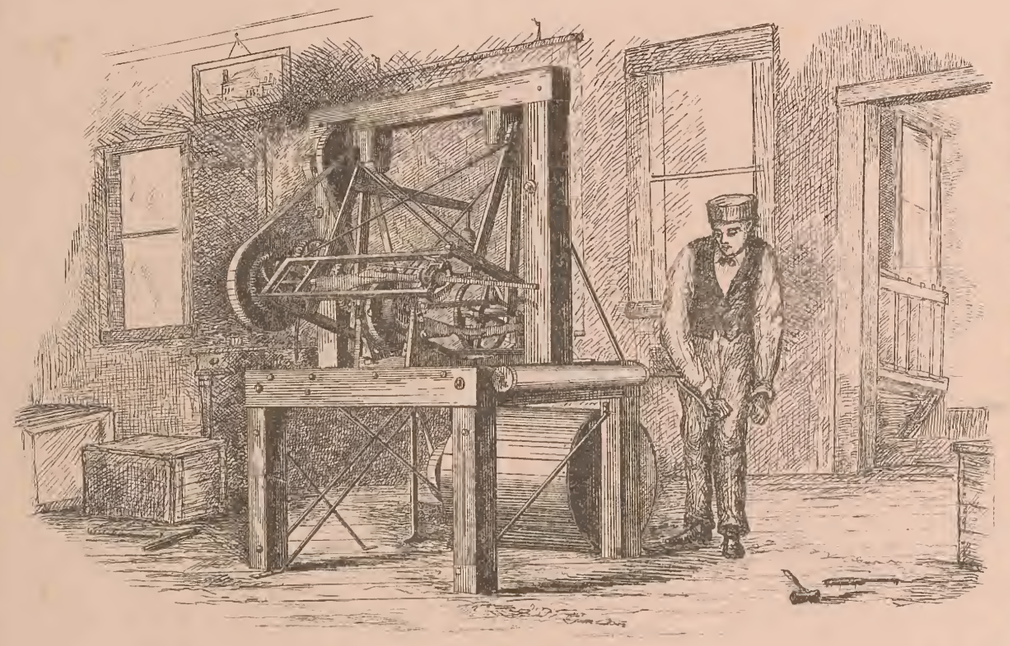
Sackett & Wilhelms Litho Co New York



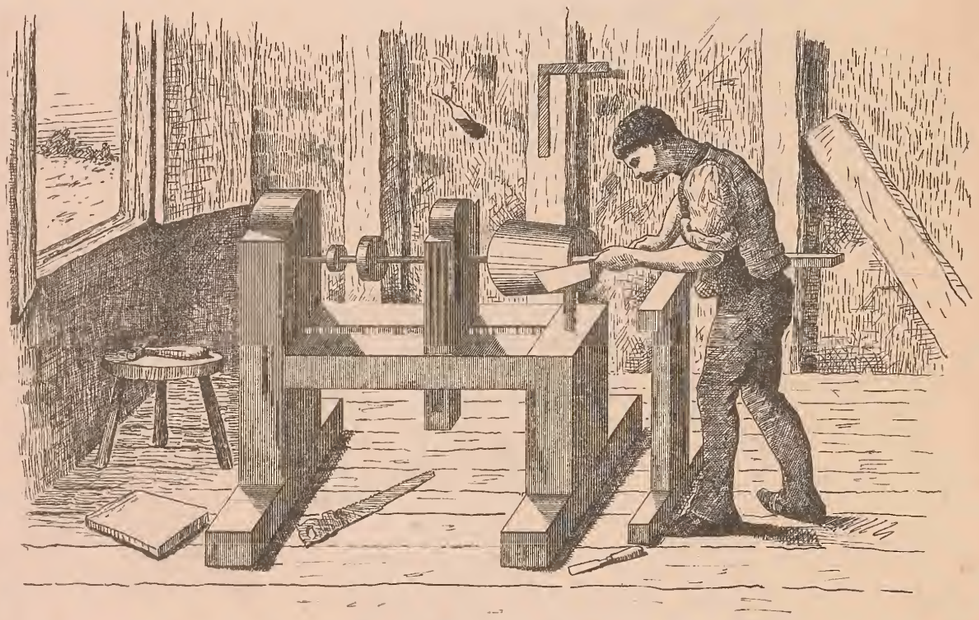
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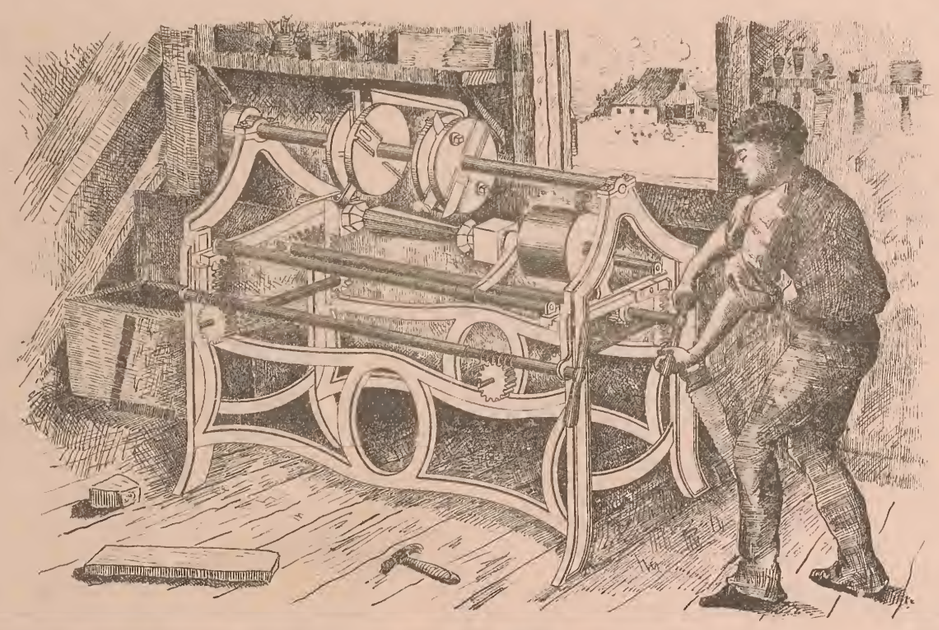
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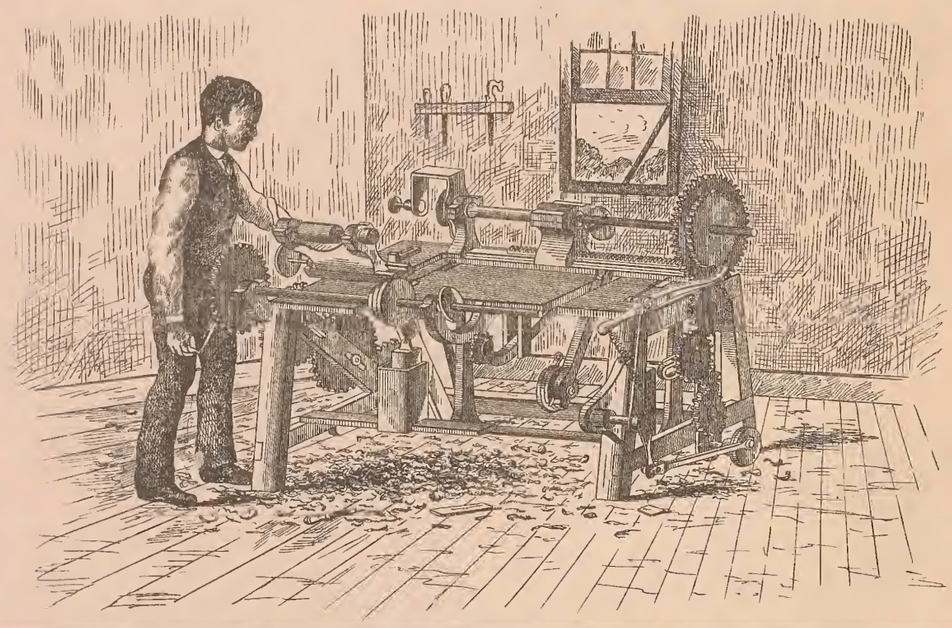
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6

WOOD WORKING--TURNING.

WOOD WORKING---TURNING.

No. 1. Primitive Turning Cylindrical Forms—A. D. 1775.
2. " " " " —A. D. 1775.
3. U. S. Patent, Gun Stock Lathe--A. D. 1818.
4. " " Turning Wooden Trays—A. D. 1831.
5. " " " Polygonal Forms—A. D. 1852.
6. " " " " " —A. D. 1881.

The lathe, for turning wood into articles of a circular form, was invented by Talus. Pliny, however, ascribes its invention to Theodore of Samos, who flourished about 740 B. C.

With this instrument the ancients turned all kinds of vases, many of which they enriched with figures and ornaments in basso relievo.

Cicero calls the workmen who used the lathe "vasculariі."

The primitive and most simple kind of lathe is that known as the "pole lathe."

The parent of all recent machines of this kind is that invented by Thomas Blanchard, of Philadelphia, and patented by him September 6, 1819. This lathe, for turning irregular forms, contains the generic idea of all machines for duplicating shapes, by using a model in conjunction with a blank. This ingenious idea may be said to have wrought a complete revolution in that branch of wood working to which it pertains.

In the United States Patent Office wood turning machines are classed as follows: irregular forms, lathes, automatic spindles, gage, many spindle, single chuck, tubular cutter, appliances, oval forms, polygonal forms, regular forms, lateral movement, and longitudinal movement.

WOOD WORKING---TURNING.

710 Manufactories in the United States.

	1870	1880
Capital Invested, -	$2,751,544.00	$3,450,710.00
Value of Productions, -	4,959,191.00	6,770,119.00
Wages Paid, - -	1,499,565.00	2,148,914.00
Hands Employed, - - -	4,103	5,665

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